200182
5 FI R62

SZ.T.E. Klebelsberg Könyvtár
SZEGED
6.

2009

REVIEW OF FACULTY OF ENGINEERING

Analecta Technica Szegedinensia

UNIVERSITY OF SZEGED
UNIVERSITAS SCIENTIARUM SZEGEDIENSIS
FACULTY OF ENGINEERING

UNIVERSITY OF SZEGED
FACULTY OF ENGINEERING

REVIEW OF FACULTY OF ENGINEERING

Analecta Technica Szegedinensia

SZEGED
2009.

PUBLISHER:

Dr. Antal Véha
Dean, Head of Department
UNIVERSITY OF SZEGED FACULTY OF ENGINEERING

EDITED BY:

Dr. Cecília Hodúr
Vice Dean

Dr. Elisabeth T. Kovács
Professor

Dr. József Gál
Assoc. Professor

Mónika Szilágyi
administrator

PUBLISER'S-READERS

Dr. József Csanádi, PhD
Dr. Tamás Endődy, PhD
Dr. József Gál, PhD
Dr. László Gulyás, PhD
Dr. Ernő Gyimes, PhD
Dr. János Gyeviki, PhD
Dr. Ottilia Bara- Herczegh, PhD
Dr. Cecília Hodúr, PhD
Dr. Katalin Horváth-Almássy, CSc
Dr. Zsuzsanna H. Horváth, PhD
Dr. Gabriella Keczer, PhD
Dr. Elisabeth T. Kovács, CSc
Dr. Judit Krisch, PhD
Dr. Erzsébet Markovics, PhD
Dr. Tibor Marosi, PhD
Dr. György Mészáros, PhD
Dr. Zsuzsanna László, PhD
Dr. Robert Rajkó, PhD
Dr. József Soós, PhD
Dr. István Tibor Tóth, CSc
Dr. Antal Véha, CSc
Dr. Edina Vincze-Lendvai, PhD

NUMBER OF COPIES PRINTED: 100

Norma Nyomdász Kft. Kiadó és Nyomda
6800 Hódmezővásárhely, Rárósi u. 10.

ISSN 1788-6392
UNIVERSITY OF SZEGED FACULTY OF ENGINEERING
H-6724 Szeged, Mars tér 7.
Phone: +36 (62)546 000

CONTENTS

FIAT PANIS! LET THERE BE (ENOUGH) BREAD! THOUGHTS ON THE PROBLEMS OF WORLD'S FOOD SUPPLY IN THE 21ST CENTURY

Tünde Baló
University of Szeged, Faculty of Engineering

ABSTRACT

In the last few days those who are interested in the real problems regarding our earth could hear from the news that the food shortage is growing all over the world, which leads to an increased tense or even to a „revolt". What is all about? It is about that now, at the beginning of the 21st century the problems of world's food supply are added together and are growing worse because two other global problems have joined to the previous ones: the climatic changes and the energy crisis. I think that these new troubles cannot be understood well without mentioning the antecedents.

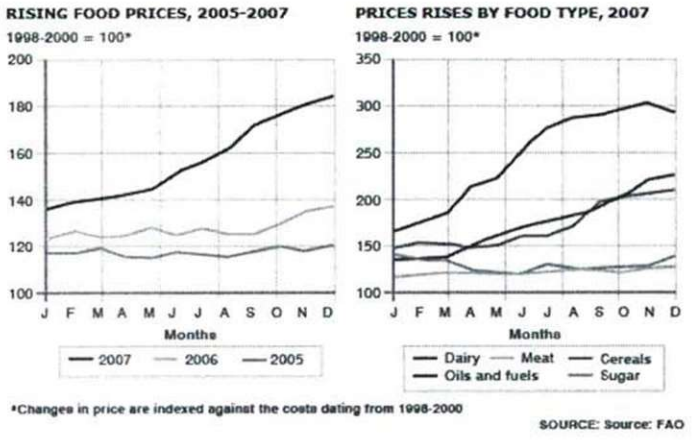
1. THE ANTECEDENTS

The Food and Agriculture Organization of the United Nations (FAO) has been regarding the appeasing of the problem of world's food supply one of its most important tasks since its foundation in 1945. The FAO Charter stabilizes the intentions of the founders, the mission of the Organization. According to which the founding states, together and individually, guarantee that they do everything to improve nutrition, to raise the living standards, to improve the efficiency of production and distribution of food, to better living conditions of rural population.
A lot of scientists and professionals work on these aims in their own countries and abroad on behalf of FAO. Since 1968 the world's scientists has been calling the attention to global problems, among them the vital topic is the world's food supply, first in the Roma Club, then in different analyses, too. Besides, there are more optimal predictions which find possible that agriculture can be taught to the population of starving countries. Others thought that the size of arable lands would be enough to provide food for even 6 thousand million people. Although these world models ignored the overpopulation of developing countries, nobody could predict the worldwide shortage of power resource, caused by the quick development of BRIC-countries, which directly affects the world's food supply – due to the lack of energy carriers and the energy-oriented food production.

The food shortage has been growing worse since the colonies fell to pieces. After the colonizing powers had been forced to withdraw, in several free countries the rival powers induced political instability by trying to seize and maintain the power with guns. In countries like this (mainly in Africa), for decades it has not been the agricultural development which stands in the focus of politicy, what is more the food aid collected by FAO in developed countries lands on the black market and are exchanged for guns. Especially in Africa the problems are doubled with the extreme drought which carries further consequences: price increase in the international market (Figure 1 and 2), migration and riots locally.

2. PRESENT SITUATION

Price rise caused riots in several developing countries, for example in Egypt, Bangladesh and Haiti. In Zambia the country's food reserves had become exhausted by July-August. This year there is a 630 thousand tons shortage of maize which is the main nutriment there. (In the last economic year floods and then drought reduced maize production from 700 thousand tons to 490 thousand tons.) In some, hardly approachable regions of the country more and more people are compelled to eat roots. Zimbabwe, at the beginning of May, declared a three-month-long state of emergency to alleviate the situation of its 600 thousand citizens threatened by starvation. There even the political crisis makes the supply organization more difficult. It was a day before the warning of Zambia that the UN published its warning according to which soon 10 million people in four African countries –Malawi, Zimbabwe, Lesotho and Swaziland- would be threatened by starvation to death if they did not get an urgent international aid. The food-aid programme (WFP) of the UN reports that this region should import almost 4 million tons of food in the following year to meet all the demands of its population.



Figures 1, 2.: Data about the changes of food prices between 2005 and 2007. 1998 – 2000= 100%

And it is not everything. As FWP estimates now about 6,5 million people are starving in North-Korea with population of 23 million, but this number may increase without international help. In 2008 the shortage will double comparing to the previous year. According to the World Bank's report altogether 862 million people were starving between 2002 and 2004, 830 million of which lived in developing countries.

3. FOOD SHORTAGE IS THE QUESTION OF SECURITY, TOO

Wars can be evoked by the race for accessible food. As the supply is getting more and more reduced and as prices are increasing in the long run, so they together will result in serious consequences on security policy. Starvation can lead to riots and civil wars. In the international relations the race for food supply and migration can increase the tense, and in extreme situations it causes conflicts and wars. For example when the price of the rice went up, it led to social problems in several places, in Darfur (Sudan) and in Bangladesh

people in large groups fled across the frontiers looking for water and food. The increasing food prices are threatening millions of people with poverty. In certain parts of Haiti, Egypt, the Philippines and Western Africa the authorities had to face riots after the price of rice, wheat and soya had gone up.

The World Bank has announced that it implements the state of crisis to find solution for bringing the food price under control all over the world. Robert Zoellick, the President of the World Bank, warned us that the constantly increasing food prices affect about 100 million people in developing countries who are sinking into an even more desperate situation.

The question is if the developed countries of the world will be able to help countries which suffer from the lasting food shortage. We must admit that while hundreds of million people are in grave need and hundreds of thousand children swell and then die because of the lack of the everyday food, in other countries some ten million people are fighting with health problems because they are overfed. During my studies I often have to face data which show that in the USA 30% of the population, in Spain 13,1% and in Germany 12,9% is corpulent, but the rate of the overweight population, which cannot be considered corpulent, is even bigger. There are more and more overweight people also in Hungary and the future of fat children is especially alarming.

Knowing all these, can we expect that this not-real (because not being on the market) excess of food can be redistributed to help countries with food shortage? I think it is not likely. Fistly, because to realize that corpulency is not only the question of health or aesthetics but of ethics is a very slow process and renunciation the excess will hardly result redistributable founds. Secondly, because the climatic change, which is the other important subject of my essay, means such an unpredictable threaten which can reduce even the food supply of the developed countries. Finally, because the energy-oriented use of foods reduces the human-oriented use in the balance of products.

4. WHAT DO WE MEAN BY CLIMATIC CHANGE?

IT is a long-lasting change of weather factors which affects the production results of foods. The „climatic change" is often identified with the lasting global warming. According to model-calculations the global warming means that the average temperature a year will increase with 3-3,4 °C within 70-75 years;

- it will raise the sea levels;
- the water will flood lands and
- the amount of arable lands will decrease;
- because of the higher temperature the evaporation will grow and the soil will get dry more quickly;
- what is more use of water for agricultural purposes will be more limited than now because
- the higher temperature will result in an increased community and industrial use; and it may restrict the agricultural use of water.

Some further disadvantagous agrotechnical consequenses can be expected in the case of agricultural production. For example:

a) Warming will affect favourably the reproduction, hibernation and general spreading of plant pests, and the protection against them will mean a factor which increase the costs;
b) Species of cultivated plants which cannot adjust to the new climatic conditions will be eliminated from production. To substitute them professionals should start in time to improve new species which endure the new environmental conditions well.
c) On continental level the use of fieds can significantly change according to the climatic change. As Harmos, Zsolt calculates, a global rise in temperature with 1°C will push the cultivation zones with 250 km towards the poles. It means for Hungary, as an example, that only a rise in temperature with 2°C completely changes the climatic conditions, and the new climate of Mediterranean type will make a wholly different use of fields possible.

The analyses allow us to conclude that the shift of agro-ecological zones will affect the agriculture of the developed countries less harmfully, what is more, with rational water usage, it can result positively. However, the agricultural production in the developing countries might as well decrease with 10 percent which will sharpen the grave supply problems. Finally, in the tropical and subtropical regions, especially in the Sahel-zone, the situation will be critical, even catastrophic.

5. THE SLOW WARMING OF THE CLIMATE HAS BEEN EXPERIENCED FOR YEARS

The climatic change has quickened the process of the food shortage because the areas which were normally sources of food have undergone one by one an extreme, climatic change of droughts. It led to the situation that in the two most populated BRIC-countries, in India and China, the need for foods had increased. Furthermore, while the food-production per person decreased globally, the expenses of production rapidly increased. At present the demand for the „bio-fuel" extremely quickly increases because of the high prices of the old energy sources. It means that huge agricultural areas, which otherwise belong to the global food supplying system, will be used for this new demand. Professionals all over the world are warning people that these events together will lead to very dangerous, increasing crises in the future.

Supporters and opponents of the fuel production for energy have made lots of strong arguments for and against. I tried to orientate myself among these arguments so that firstly I put the present amount of the global food shortage then the quantitative data of energy-aimed food production next to each other.

According to Jacques Diouf, the director general of FAO, the world's food production should be doubled until 2050. It is needed to provide the global population of potentially 9 thousand million with food. In the meantime the donor countries have to expend 30 thousand million dollars a year on food aids to help population of permanently starving countries and to solve the crisis caused by the extreme price at present. The director general of FAO told an economic paper in London that „people are dying of the food crisis, governments are falling because of it, and a lot of ambitious democracies can „tilt to any direction" depending on the satisfaction or dissatisfaction of their population."

The need for a quick food-production-increase has been indicated by independent analyzing institutions, too. According to the overall analysis published by the British Royal Institution of Foreign Affairs – or as mostly known, Chatman House- the increasing demand for food from the part of the wealthier joining economies and the production of the bio-fuel forced up the global food-price by 83 per cent in the last three years, and „nearly revolutional" steps are needed to balance the food-suply again. The analysis quoted the estimation of World Bank according towhich the food production has to be increased by 50 per cent until 2030 – and the meat-production by 85%- to meet the predicted demands.

6. THE SHORTAGE OF FOOD LED TO PRICE RISE

As FAO says in the last two years the food prices increased by 71 per cent globally, on average. This increase led to riots in several developing countries, among them are Egypt and Bangladesh. London presses report that there is a certain level of shortage of some basic foods in such developed countries like Great-Britain and the USA, too. Brazil, which produces the most rice, stopped the rice export, so in the USA –but in certain British supermarkets, too- the rice purchase had to be restricted because of the shortage.

Though the global food shortage „did not hit the mark" in Hungary, certain signs could be felt in 2007 even here. According to Gráf József minister, who is the most competent person in this case, the Hungarian food prices went up by their tenth on average, but there are several goods for which we have to pay much more than a year ago. (For comparison it is worth taking into consideration that the food prices of EU-15 increase by 1,5-2,0 % a year, through decades.) According to the minister „ last year a litre of vegetable oil cost only 250 Fts, now it is doubled. Milk and bread cost by their fifth more than in 2007, and cheese went up by its third. In spite of these facts we will not have shortage of food, and this year the food price will increase by 10 % at most."

The Real Reason for the Deepening of Food Crisis is the Spread of Bio-Fuel

Before the congress of G8s, organized in the island of Hokkaido between 7 and 9 July, a British daily paper (The Guardian) quoted a World Bank's report – not published that time - according to which the rape and maize-production rate devoted to bio-fuel production evoked the worldwide shortage of food. It was refused by the official American positions blaming the unfavourable weather for the food shortage and the price increase. According to the World Bank, and in opposition of the arguments of the United States, the rise of the food price by 75% is not the result of the unfavourable weather conditions. As the official American standpoint says the bio-fuel production obtained from cultivated plants is responsible for only less than three per cent of the food price increase.

According to the World Bank's report the bio-fuel production destabilizes the food market in three different ways. The first one is that it shifts the use of grain from feeding to the fuel production. Nowadays 30 % of the American maize production is directed to make ethanol, while in the countries of the EU nearly half of the vegetable oil is used to make bio-diesel. The second one is that it motivates the agricultural producers to grow plants suitable to make bio-fuel from them, and the third way is that a financial speculation has started on the grain market.

The Hungarian situation supports the latter standpoint rather than the official American explanation. The sown area for human-purposes has been reduced even in Hungary, and instead of it the production of the basic materials for bio-ethanol and bio-diesel (rape and maize) have come to the front. Its signs are shown as, according to the KSH database, the production area of rape has increased by 46% recently, so the last year's result was 490 thousand tons on 219 thousand ha, which means an increase of 54%. In our country in 2007 grain was grown in 2,8 million ha of fields which is smaller by 5% than the previous year's rate. The production result fell strinkingly last year, the result was by 9% less from wheat, while by 50% less from maize. It is expected that production of basic materials for bio-ethanol will significantly drive the grain production for human purposes out which will result in the increase of food price again.

The ones who follow the events of the food crisis with care and attention have to see that the great powers and the world organizations appear only after the spread of the problem to express their standpoints or to show the „only blissful" solution. It is only the FAO which has been working consistently according to the principles stabilized at the time of its establishment in 1945, though it is not always and not enough supported by the great powers. However, we should remember that the aims and methods of FAO are not adequate to solve problems which need a sudden operative intervention, like the present starvation in one part of the world and the waste of food reserves to produce energy in the other part.

The most terrible fact is that all the leaders of the world worked together to lead the world's population into this critical situation. They are responsible for doing nothing to stop the global climatic change and for hindering others to do something against it. They are responsible for allowing the use of chemicals which led to the pollution of drinking water all over the world. However, we have to face the even more desperate fact that we, too, are responsible for not living a sustainable, environment-conscious life. (Gál 2005)

7. WHAT CAN WE DO?

There is a question in this situation: what do our children inherit from us? I agree with what Al Gore said in one of his presentations: „We have to understand wholly what is really happening and **we have to develop our sensitivity to the urgency of the situation,** and we have to do all our best to improve it. We should not underestimate the little thing that you or me, we together can do for it either today or in the following days." I think we should do something every day for the „ethical" food consumption or for lessening waste.

We - even here, in Hungary- can call upon politicians for fighting more persistently to stop those out-of-date old principles of the EU's common agricultural policy like for example the restriction of the agricultural production. I learnt, and it is also a fact that at least the half of the EU's market-controlling tools is destined to prevent excess formation in the market. Considering the food shortage in the world it is hard to understand that it is a real excess. It is a fact that this „excess" cannot be converted into food aid but it is unnecessary in case of the financial contribution from the developed countries. Hungary can contribute efficiently to solve this present problem of the world food supply if the EU does not hinder her to increase the agricultural production. „We should produce more, we have to do exactly the opposite of what the EU said, though we have been saying it for years"-said Gráf, József Minister of Agriculture and Rural Development. According to the minister

Hungary should produce by the third more for not having a shortage of food. Is it possible? My determined opinion is that yes, it is. Since there was a period (in the 1970's) in the agrarian history of Hungary when she belonged to the leading countries regarding the amount of wheat, maize, apple and green pees etc. production per person.
Besides, I consider education outstandingly important to develop the environmentally-friendly agricultural production, to teach the rational, healthy nutrition and ethical consumption, to reduce waste and to raise the interest toward the solidarity with those who are starving.

REFERENCES

1. UN calls for farming revolution. BBC NEWS, 15 April 2008.
2. The cost of food: Facts and figures. BBC NEWS, Tuesday, 8 April 2008.
3. www.fao.org 2008.04.08.
4. Gál, J. (2005): Some Agricultural Aspects of Environmental Market (Aspecte agricole legate de mediul de piata; A környezeti piac néhány mezőgazdasági összefüggése) (angol nyelven) Facultatea de Management Agricol, Universitatea de Stiinte Agricole si Medicina Veterinara a Banatului Timisoara, (angol nyelven), Simpozion Stiintific, Management si Dezvoltare Rurala, 2005.05.26-27. Timisoara, România, pp. 89-96.

RESEARCH ON ALVEOGRAPHICAL PARAMETERS OF WINTER WHEAT (*T. AESTIVUM*) VARIETIES

Ágnes Pongrácznė Barancsi[a*], Zoltán Mezei[b], Zoltán Győri[c], Péter Sipos[c]

[a]Technological and Agriculture Faculty of Szolnok Collage, 1 Petőfi Square, Mezőtúr H-5400

[b]Hajdúsági Gabonaipari Inc., 13 Széchenyi Street, Debrecen H-4025

[c]University of Debrecen Centre for Agricultural Sciences and Engineering Faculty of Agronomy, Institute of Food Science, Quality Assurance and Microbiology, 138 Böszörményi Street, Debrecen H-4032

e-mail: postmaster@turagro.t-online.hu

ABSTRACT

Nowadays, many methods have been worked up in the interests of objective expression of winter wheat rheological quality. These define wide sprektrum in view of their complexity and apparatus claim.

We have to know the new, untraditional quality parameters because of satisfy both costumers of the Europe Union and the export market. The ambition of importers is shown by the fact that needs of certain suppliers and costumers for the alveographical parameter has increased.

Hungary could come in the uniform EU wheat market with special Hungarian wheat and stabilised good quality if we innovate the rheological characteristics. We have to find extra information about the baking value of winter wheat varieties and the qualification of export rate and we have to select special quality types for wheat growing.

In our research we examined the alveographical parameters of 10 winter wheat varieties (GK Kalász, GK Csillag, GK Élet, GK Garaboly, GK Verecke, GK Csongrád, GK Petur, GK Piacos, GK Kapos, GK Hattyú) in Szeged (Hungary) on the basis of the results in three years (2005-2007). We established with correlation analysis that is no statistical relation between the W and G; W and L parameters.

1. INTRODUCTION

The definition of quality has widened with meeting the market needs and costumer-oriented approach. More and more claim appear for special reological characteristics of dough on Hungarian and international wheat market.

The quality of wheat is a complex concept (Lásztity 1980, Véha and Gyimesi 1999, Matuz et al., 2007, Pepó 2007, Tanács 2007).

The Alveograph is suitable for the examination of rheological characteristics which characterises the extensibility of dough (Rakszegi et al., 2005).

The Alveograph qualification of wheat samples is a current method in the French professional word, but it is preferred in West-Europe and Europe Union, too. This method gives extra information for backing tests (Zsikla, 2005).The Alveograph is a modern model of Hankóczy Farinometer. The specialisation of the Alveograph is that: this machine deforms the dough not only in one, but more directions. In the meantime it originates a dough bubble from the dough; in other worlds it imitates the enlargements in the rising dough. The indexes of alveogram are the followings: P (mm) as pressure, L (mm) as break abscissa, G (ml) as swelling index, W (10^{-4}J) as deform work and P/L as a configure or relative of graph. The interpretation of the alveographical characteristics are equal with the extensographical characteristics (Markovics 2004). The attitude of graph means the resistance to extension, the length of graph means the extensibility, the subarea of graph is the energy (Faridi and Rasper 1987).

Vida et al. (1996) analysed the relation between the alveographical and other baking industry quality characteristics of 19 winter wheat varieties and they established the close positive correlation between the alveographical G, W and gluten index with statistical method. The alveographical G and W are in satisfactory significant relation with the wet gluten content.

Matuz el al. (1999) established the values and the value relation of 13 parameters (among others alveographical P, L, P/L, W, G wet gluten content, spreading of wet gluten) of 29 winter wheat varieties produced in 1995, 1996 and 1997. They used double correlation, factor analysis, polyvariable regression analysis and stepwise regression. The aim of their analyses was to define the parameter that has the closest correlation with the alveographical W. They stated that the majority of correlation is different annually.

2. MATERIALS AND METHODS

The 10 representative winter wheat samples (GK Kalász, GK Csillag, GK Élet, GK Garaboly, GK Verecke, GK Csongrád, GK Petur, GK Piacos, GK Kapos, GK Hattyú), which were produced in 2005-2007, originate from the Kecskés breeding station of the Cereal Research Non Profit Company (Hungary). The plot size was 20 m^2/variety, and the wheat types were produced without repetition.

The flour was made in Metefém FQC 109 Labor mill. The quality complied with the requirements of the MSZ 6367/9-1989 standard. The specification of the moisture complied with the requirements of the MSZ 6369/4-87 standard. We made Alveograph examinations with Alveograph by Chopin (AACC 1983.54.30.). The Alveograph examinations were performed in the Laboratory of University of Debrecen Centre for Agricultural Sciences and Engineering Faculty of Agronomy, Institute of Food Science, Quality Assurance and Microbiology. We used SPSS 12.0 for Windows, which runs on Microsoft Windows 2000 operation system.

3. RESULTS AND DISCUSSION

The changes of alveographical parameters

The four types in baking industry are grouped according to alveographical W (deform work) in some member states of Europe Union. In table 1 the GK Kalász variety presents the highest parameter in tree years (in 2005 $469*10^{-4}$J/g, in 2006 $459*10^{-4}$J/g, in 2007 $421*10^{-4}$J/g) and GK Garaboly shows the lowest value in 2005 ($83*10^{-4}$J/g), in 2006 ($89*10^{-4}$J/g) and GK Hattyú in 2007 ($144*10^{-4}$J/g).

We can see that similar situation in the case of average P value, too. GK Kalász shows P=95 mm in 2005, P=93 mm in 2006, P=90 mm in 2007. We analysed the lowest values of GK Garaboly. It was 23 mm in 2005, 29 mm in 2006 (GK Csongrád, too) and 30 mm in 2007.

We can see high L parameters in view of GK Petur in 2005 (253 mm), GK Csongrád in 2006 (203 mm) and in 2007 (209 mm). We analysed low L parameter in view of GK Kapos in 2005 (113 mm), GK Piacos in 2006 (121 mm) and GK Élet in 2007 (103 mm).

We count the G parameter from L, so the G values present similar tendency in tree years. In 2005 and in 2007 the L and G values in view of Petur were the highest parameters and GK Kapos presented the lowest parameters.

Table 1. The alveographical parameters of analysed winter wheat varieties (Debrecen, Hungary 2005-2007)

year	variety	W (10^{-4}J/g)	P (mm)	L (mm)	P/L	G (cm^3)
2005	GK Kalász	469	95	150	0,63	27,19
	GK Csillag	262	82	121	0,68	24,42
	GK Élet	162	47	159	0,30	27,99
	GK Garaboly	83	23	225	0,10	33,30
	GK Verecke	316	74	133	0,56	25,60
	GK Csongrád	116	40	160	0,25	28,08
	GK Petur	194	33	253	0,13	35,31
	GK Piacos	220	53	152	0,35	27,37
	GK Kapos	179	64	113	0,57	23,60
	GK Hattyú	122	27	197	0,14	31,16
2006	GK Kalász	459	93	146	0,63	28,24
	GK Csillag	247	70	130	0,53	25,61
	GK Élet	183	43	163	0,26	25,00
	GK Garaboly	89	29	181	0,16	23,15
	GK Verecke	302	76	152	0,50	28,06
	GK Csongrád	127	29	203	0,14	29,56
	GK Petur	212	53	174	0,30	30,12
	GK Piacos	257	72	121	0,59	24,70
	GK Kapos	214	55	192	0,28	29,56
	GK Hattyú	146	52	186	0,27	30,98
2007	GK Kalász	421	90	147	0,61	27,00
	GK Csillag	248	74	134	0,55	25,80
	GK Élet	213	70	103	0,68	22,60
	GK Garaboly	169	39	167	0,24	28,80
	GK Verecke	271	58	176	0,33	29,50
	GK Csongrád	171	40	209	0,19	32,20
	GK Petur	249	51	201	0,25	31,50
	GK Piacos	243	68	135	0,51	25,80
	GK Kapos	192	72	105	0,69	22,80
	GK Hattyú	144	30	200	0,15	31,50

Correlation among the analysed parameters

In table 2 are close linear positive correlation between the following parameters in 2005: W and P (0,886), W and P/L (0,747). Negative linear correlation is between the followings: P and L (-0,750), P and G (-0,757). We count the P/L value from P and L, the G from L , so there is no sense of the correlation in this situation. There is no statistical relation between W and G and W and L.

Table 2. Correlation among the analysed parameter in 2005

	W (10^{-4}J/g)	P (mm)	L (mm)	P/L	G (cm^3)
W (10^{-4}J/g)	1				
P (mm)	**0,886	1			
L (mm)	-0,412	*-0,750	1		
P/L	*0,747	**0,965	**-0,856	1	
G (cm^3)	-0,413	*-0,757	**0,998	**-0,869	1

** Correlation is significant at the 0.01 level
* Correlation is significant at the 0.05 level

We can see in table 3 similar situation as in table 2. There are close linear positive correlation between W and P (0,936), W and P/L (0,868). There are negative linear correlation between W and L (-0,606), P and L (-0,735). There is no statistical relation between W and G, W and L, P and G.

Table 3. Correlation among the analysed parameter in 2006

	W (10^{-4}J/g)	P (mm)	L (mm)	P/L	G (cm^3)
W (10^{-4}J/g)	1				
P (mm)	**0,936	1			
L (mm)	-0,606	*-0,735	1		
P/L	**0,868	**0,957	**-0,887	1	
G (cm^3)	0,098	0,076	0,508	-0,151	1

** Correlation is significant at the 0.01 level
* Correlation is significant at the 0.05 level

We present the date in 2007 in table 4. There are close linear positive correlation between W and P (0,769) too. There are negative linear correlation between P and L (-0,743), P and G (-0,730). There is no statistical relation between W and G, W and L, W and P/L.

Table 4. Correlation among the analysed parameter in 2007

	W (10^{-4}J/g)	P (mm)	L (mm)	P/L	G (cm^3)
W (10^{-4}J/g)	1				
P (mm)	**0,769	1			
L (mm)	-0,200	*-0,743	1		
P/L	0,445	**0,902	**-0,944	1	
G (cm^3)	-0,175	*-0,730	**0,999	**-0,943	1

** Correlation is significant at the 0.01 level
* Correlation is significant at the 0.05 level

The results of correlation analysis present in three years, that W and P positive, P and L negative connection are to each other and there is no statistical relation between W and G, W and L parameters.

4. SUMMARY

We have to know the new, untraditional quality parameters in Hungary, which satisfy the costumers of the Europe Union and the export market, too.
The gluten examination test is dominant in Hungary. It has its own reasons and traditions.
Hungary could come in the uniform EU wheat market with special Hungarian wheat and stabilised good quality if we innovate the rheological characteristics. The costumers decide about the conditions of EU and Hungarian market and the research innovations often aim at them.
The pizza-, strudel-, puff- and creeker flour types are curiosity flour types in the French, Polish, German, Dutch and Italian dough flour market. These flour types are required to have the followings: extensographical extensibility and alveographical "P" parameter.
More and more laboratories have Alveograph in Hungary. If we can standardize the claimed parameters, the market and the customers will be satisfied with Hungary. It is important to give the correct, fast specification of the claimed parameters. We have to find extra information about the baking value of winter wheat varieties and the qualification of export rate and we have to select special quality types for wheat growing.
In our research we examined the alveographical parameters of 10 winter wheat varieties (GK Kalász, GK Csillag, GK Élet, GK Garaboly, GK Verecke, GK Csongrád, GK Petur, GK Piacos, GK Kapos, GK Hattyú) in Szeged (Hungary) on the basis of the results in three years (2005-2007), which were produced in 2005-2007, originate from the Kecskés breeding station of the Cereal Research Non Profit Company.
The alveographical W value plays impotent roll in baking industry in some member states of Europe Union. The GK Kalász variety presents the highest parameter in tree years and GK Garaboly the lowest value in 2005, 2006 and GK Hattyú in 2007.
We established with correlation analysis in three years that is no statistical relation between the W and G; W and L parameters.

This extra information can give us help to select special quality types for wheat growing and qualify the different export rate.

REFERENCES

1. American Association of Cereal Chemists. (1983): Alveograph Method for Soft and Hard Wheat Flour. 54.30A. The Association: St. Paul, MN.
2. Győri és Győriné Mile.I. (1998): A búza minősége és minősítése. Mezőgazda Szaktudás Kiadó, Budapest. 37-44p.
3. Faridi, H., Rasper, V.F. (1987): The Alveograph Handbook. AACC. St.Paul, Minnesota, USA.
4. Lásztity, R. (1980): Correlation between chemical structura and rheological properties of gluten. Ann.Technol. Agric. 29.339-361 p.
5. Lásztity R.-Molnár P. (2001): Búzatermelés és búza minőség az EU országaiban. Molnárok Lapja. 106. évf.2001. évi 3. szám.5-7.
6. Markovics E. (2004): Őszi búza lisztek sütési tulajdonságainak összefüggésvizsgálata. PhD Értekezés. DE-ATC, Debrecen.
7. Matuz, J., Markovics E., Ács, E., Véha, A. (1999): Őszi búza fajták lisztjének tulajdonságai közötti összefüggések vizsgálata. Növénytermelés. 3. 243-254 p.
8. Matuz, J., Kirsch J., Véha A., Petróczi, I. M., Tanács L. (2007): Effect of the fertilization and the fungizide treatment on the alveographic quality of winter wheat. Cereal Research Communications, 35: 2. 1193-1196 p.
9. MSZ 6367/9-1989. Élelmezési, takarmányozási, ipari magvak és hántolt termények vizsgálata. A búzaliszt laboratóriumi előállítása.
10. Pepó, P. (2007): The role of fertilization and genotype in sustainable winter wheat (Triticum aestivum L.) production. Cereal Research Communications, 35: 2. 917-920 p.
11. Rakszegi, M., Láng, L., Bedő, Z. (2005): Tészta nyújthatóság vizsgálatok a búzanemesítésben. Martonvásár, 2005/1. 12-13 p.
12. Tanács, L. (2007): Seasonal and genotype effect on the alveographical value of winter wheats. Cereal Research Communications, 35: 2. 1197-1200 p.
13. Véha, A., Gyimes, E. (1999): Investigation of kernel hardness in winter wheat varieties with hammermill. Cereal Research Communications, 27. 4. 463-470 p.
14. Vida, Gy., Láng, L., Bedő,Z. (1996): Őszi búzák alveográfos és más sütőipari minőségi tulajdonságai közötti összefüggések elemzése főkomponensanalízissel. Növénytermelés. MTA Mezőgazdasági Kutatóintézete, Martonvásár. Tom.45.No.56.435-445 p.
15. Zsikla, A. (2005): Az alveográfos tésztaviselkedés és a sütési teljesítmény kapcsolatának vizsgálata. http://www.food.kel.hu/tdk/2004/szekcio3.pdf. 2005.12.02.

EXAMINATION OF PHISICAL PARAMETERS OF PECTIN GELS EXTRACTED FROM FRUIT PRESSCAKES

Sándor Csató, Mária Fekete
University of Szeged, Faculty of Engineering

ABSTRACT

In our study we aimed to investigate the rheological and colour characteristics of the pectin gels extracted from presscakes of berries. The pectins extracted from the presscakes of five different fruits such as black-currant, red-currant, raspberry, blackberry and elderberry, were used for the examinations. Two commercial materials were applied as controls: apple and citrus pectins. The rheological examinations showed that the pectins obtained from the red-currant presscake have the best gelificator properties. The analysis of the colour coordinates revealed that the gel of the citrus pectin used as control is very clear and translucent such as the pectin gel of the red-currant. The pectin gels of black-currant, blackberry, elderberry and raspberry contain a significant amount of colourants, in this way they are very dark.

1. INTRODUCTION

The presscake obtained by pressing fruit juices in the traditional process increases the quantity of technological waste. Generally it's further used as forage compound or compost. However in case of the aforementioned exploitation the useful substances that remain in the presscake after pressing get wasted, such as pectin, minerals, vitamins, colorants for the berries. Pectin is used in food-industry as gelificator, volume expander as well as stabilizer. The presscake or rape resultant from berries, contains important quantities of pectin, which is worth to be extracted, and whose characteristics deserve further examination.

In our study we aimed to examine the rheological and color characteristics of pectin gels extracted from berries, and to compare them with the corresponding values of commercial apple and citrus pectins.

2. MATERIALS AND METHODS

The pectins extracted from the presscakes of four different berries were used during the examinations, namely: black-currant, red-currant, raspberry and elderberry. Two commercial materials were applied as controls: apple and citrus pectins.

Rheological analysis

For the examinations a gel was prepared from each pectin the following way:
150 ml water+ 5g pectin+ 60g sugar+ citric acid (pH:3.5) to adjust the pH, heating up to the boiling point applying continuous stirring, then cool to 20°C.
The analysis was carried out using a RHEOTEST 2 rotational viscometer thermostated at 20°C. S1 plate was used for red-currant, raspberry elderberry and apple pectin gels, and H plate for citrus and red-currant pectin gels.

The shearing stress (τ) were determined in the 0,166-145,8 1/s speed gradient (D) range. The apparent viscosities were calculated by the $\eta=\tau/D$ equation with the same speed gradient.

The colour analysis

The colour of the pectin powders and gels were characterized by the CIE L*a* b* colour coordinates determined by a Hunter MiniScan spectrofotometric colour analyzer. The software of the instrument determined the colour coordinates from the reflection spectrum of the gels, recorded in the wavelength range of 400-700 nm, applying 1cm thick layer of 20°C gel poured in an optical glass measuring jar, using white background. For the analysis of the powders the same jar was used, filled 1 cm high.

3. RESULTS AND DISCUSSION

Results of rheological analysis

The flow curves (the shear stress in function of the speed gradient) of the pectins obtained from the press-cakes and the commercial control apple and citrus pectins are represented together (Fig. 1). τ(Pa) indicates the shear stress and D(1/s) the speed gradient.

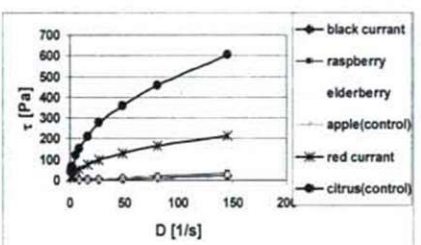


Figure 1. Flow -curves of control pectin gels and pectin gels prepared from fruit presscakes

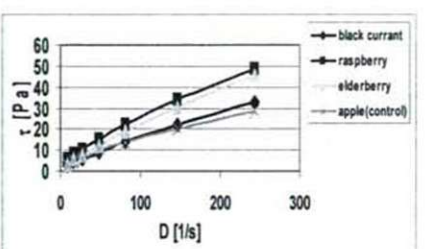


Figure 2. Flow-curves of apple pectin gel and pectin gels prepared from fruit presscakes

The form of the flow curves show that the gels of the control citrus pectin and the pectin obtained from the red-currant presscake behave as general Newtonian fluids, their rheological description can be given by the Ostwald-equation $\tau = K \cdot D^n$, where K and n are constants. The value of n is the flow index that shows the deviation from the linear . The variation of the flow index indicates the variation of the apparent viscosity. Fig. 1 shows also that the flow characteristics of the control citrus pectin gel are substantially different from those of the other pectins, it's less liquid and much more resistant for the same speed gradient. Only the pectin gel of the red-currant presscake has similar consistence.

In Fig. 2 we can compare the flow-curves of the more liquid pectin gels prepared from the presscakes of raspberry, black-currant, elderberry, and the control apple pectin gel.

The figure shows that the pectin gels of black-currant, raspberry, elderberry and apple can be considered as Newtonian fluids by their flow-curves, and have similar flow-characteristics. The apparent viscosity values calculated for a given speed gradient are presented in Fig. 3 to compare the consistence of the different pectin gels. The viscosity was calculated for a speed gradient (D) of 143 1/s applying the $\eta = \frac{\tau}{D}$ relation.

The results represented in Fig. 3 demonstrate that the citrus pectin gel and the pectin gel obtained form the red-currant presscake have 25-30 time higher viscosity values than the other studied pectin gels. The consistence of the red-currant pectin gel is similar to that of the control citrus pectin.
The mean apparent viscosities of the less viscous pectin gels with the smallest significant difference are shown in Fig. 4 together with the also little viscous apple pectin gel, used as second control.

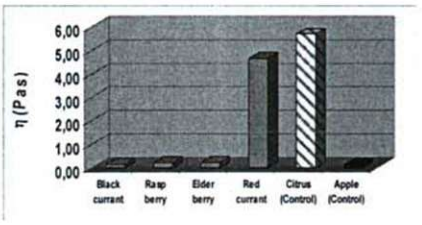


Figure 3. Viscosity of control pectin gels and pectin gels prepared from fruit presscakes

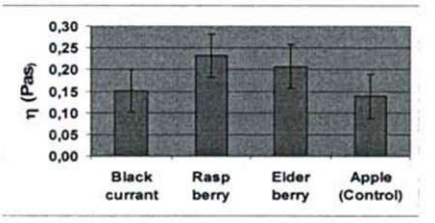


Figure 4. Viscosity of apple pectin gel and pectin gels extracted from fruit presscakes

The results presented in Fig. 4 and those of the variance analysis show that there's no significant difference in the consistence of the control apple pectin gel and that of the pectin gels obtained from black-currant, raspberry and elderberry presscakes.

Results of colour measurements

Colour characteristics of pectin powders
From the CIE L*a*b* colour coordinates of the apple pectin powder and the pectin powders obtained from the presscakes by the $C^* = \sqrt{a^{*2} + b^{*2}}$ relation we determined the chroma value, that represents the colour-saturation. The L* (lightness) and corresponding C* (chroma) values are presented in the L*-C* colour plane to compare the colour of the powders.

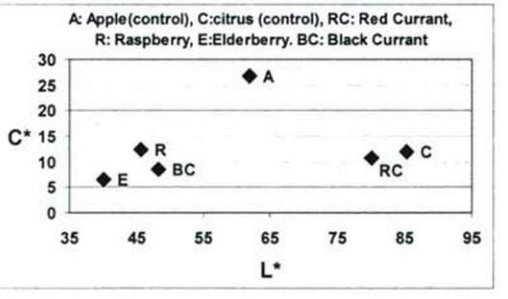


Figure 5. Colour saturation and lightness values of pectin powders

As Fig 5 shows that the powder of the control citrus pectin is the clearest and has low chroma value. The colour of the pectin powder extracted from the red-currant presscake is similar, only 3 colour units darker. Whereas the second control apple pectin is substantially

darker and colourful. There is a difference of 25 colour units. The pectin powders extracted from the presscakes of elderberry, raspberry and black-currant are approximately 40 colour-units darker then the citrus and red-currant pectins. The low lightness factor together with the low chroma value characterizes the dark-grey colour.
We can conclude that from the red-currant presscake we succeeded to produce a pectin powder alike to the control citrus pectin also regarding the colour.

Colour characteristics of pectin gels
The L* and C* colour coordinates are presented in the L* -C* colour plane to compare the colour of the different pectin gels (Fig 6.).
It can be observed that the position of the colour points correspond to the results obtained in the powder form. The most transparent is the citrus pectin gel, the clearness value of 50 results from the strong light reflection from the white background placed behind the pectin gel layer. In the case of the red-currant pectin gel slightly less light is reflected by the white background.

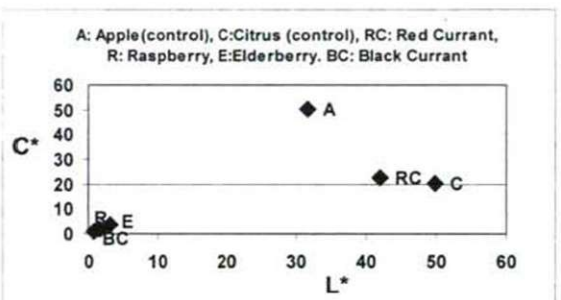


Figure 6. Colour saturation and lightness values of pectin gels

The apple pectin gel, choosed as second control is of relatively high chroma and nearly 20 units darker than the citrus pectin gel. Due to the great amount of colorants, the elderberry-, raspberry- and black-currant pectin gels are almost black. They are 40 units darker and their chroma value is below 5 units.

4. CONCLUSION

We can conclude that the gelifying properties of the pectins obtained form different raw materials can be compared and categorized by analysing their flow-curves, determined by a rotational viscometer, and the calculated apparent viscosity values.
By instrumental color measurement it is confirmed that the colour of the pectins and their gels obtained from different raw materials changes in a wide range depending on the type and quantity of the colourants remaining with the pectin.

REFERENCES

1. D. Weipert, H.D. Tscheuschner, E. Windhab (1993): Rheologie der Lebensmittel. Behr's Verlag, Hamburg, pp. 508-529.
2. Coralia Osorio, Martha Sofía Franco, Maria Paola Castaño, Maria Lourdes González-Miret, Francisco J. Heredia, Alicia Lucía Morales (2007): Colour and flavour changes during osmotic dehydration of fruits. Innovative Food Science & Emerging Technologies,Volume 8, Issue 3, Pages 353-359.
3. Gordon A. Morris, José García de al Torre, Alvaro Ortega, Jonathan Castile, Alan Smith, Stephen E. Harding. (2008): Molecular flexibility of citrus pectins by combined sedimentation and viscosity analysis. Food Hydrocolloids,Volume 22, Issue 8, , Pages 1435-1442.

THE AUTHENTICITY CONTROL OF VEGETABLE OILS USING THE TOTAL STEROL PROFILE

Francisc Vasile Dulf
University of Agriculture Science and Veterinary Medicine
3-5 Mănăstur Str., 400372 Cluj-Napoca, ROMANIA
e-mail: francisc_dulf@yahoo.com

ABSTRACT

The aim of this study was to develop a rapid and convenient chromatographic method for authenticity control of vegetable oils using the total sterol profile determined by gas-chromatography (GC) with flame ionization detector (FID). Two pure oils, rapeseed and olive oil, processed by minimal technologies (cold pressing) and an adulterated olive oil with 30 % of rapeseed oil were used as sample matrices in the method development. The rapeseed oil can be identified by the presence of brassicasterol, which is characteristic mainly for this oil. In olive oil, this sterol is absent. The concentrations of β-sitosterol, campesterol and brassicasterol as well their ratios can identify the adulteration of virgin olive oil with rapeseed oil. High ratios β-sitosterol/ campesterol are specific to virgin olive oil (~ 27.5) while these ratios are low (~2) for rapeseed oil or adulterated olive oil. Also the ratio campesterol / brassicasterol can indicate the adulteration. This ratio is low (~2) for rapeseed oil and higher (~ 4.8) in extra virgin olive oil. Adulteration of olive oil with rapeseed oil determine the decrease of this ratio. In this work we report three ways to identify the quality and authenticity of olive oil. We found as well markers which indicate if the olive oil was adulterated with rapeseed oil.

1. INTRODUCTION

Adulteration has always been practised and it is carried out for economical purposes (e.g. to increase the bulk volume, to overevaluate a product of inferior quality or to subtract/save expensive ingredients). On the other hand, contaminations may occur accidentally, e.g. in factories, where several oils are produced or used at the same time. These cross-contaminations are usually below 1 – 2 % of the total amount.

In addition, safety problems can be involved in adulterations. Tabuenca J.M. (1981) and De La Paz et al., (1996) reported about the "toxic oil syndrome" (TOS) occurred in the spring of 1981 as an epidemic in Madrid and the north central area of Spain. Over 20,000 cases of illness were documented and over 300 deaths were attributed to TOS. The primary cause for the disease was the consumption of illegally marketed edible oil, adulterated with industrial-grade rapeseed oil containing 2% aniline as denaturant. This example represents one of the most dramatic cases of a hazard to human health associated with an adulteration. An authentic product, whether raw material or a product on the supermarket shelf, is one which strictly complies with the declaration given by the producer in terms of ingredients, natural components, absence of extraneous substances, production technology, geographical and botanical origin, production year and genetic identity.

To assess the authenticity of oils it is fundamental to know, not only the biological origin of seeds, but also the technologies applied, the fat modification techniques used and the chemical composition of the authentic oil(s) and of the potential adulterants (Kamm et al., 2001b).

The fundamental problem for the authenticity assessment of fats and oils is to define one or more parameters within the lipid fraction which allow checking the identity and purity of the specified fat or oil. Ideally, such markers are chemical compounds which are present in the adulterant fat and absent in the original one. However, very often marker substances are not totally absent in the authentic fat but present only in concentrations different from the adulterated product. Therefore, profiles of authentic oils must be compared with the oil to be tested. For the definition of authenticity, the natural variations of the markers, e.g. due to climate, soil and breeding must be taken into account.

Edible oils are derived from a diverse range of plants and their origin is the primary determinant of composition. Thus, the major constituents (generally up to 98 % by mass) in all oils are triacylglycerols. Numerous minor components comprise the remainder. The latter includes free fatty acids, partial acylglycerols, sterols, tocopherols, phenols, stanols, phospholipids, waxes, squalene and other hydrocarbons. Content and composition of these components can vary due to the agronomic and climatic conditions, seed quality, and oil extraction system and refining procedures (Moreda, 2000).

Phytosterols are triterpenes that are important structural components of plant membranes. Most phytosterols contain 28 or 29 carbons and one or two carbon-carbon double bonds, typically one in the sterol nucleus and sometimes a second in the alkyl side chain. Phytostanols are a fully-saturated subgroup of phytosterols (contain no double bonds). Fig. 1 illustrates the structures of three common seed oil sterols, which show small structural variations. The other sterols have the same basic structural design as those illustrated in the Fig. 1.

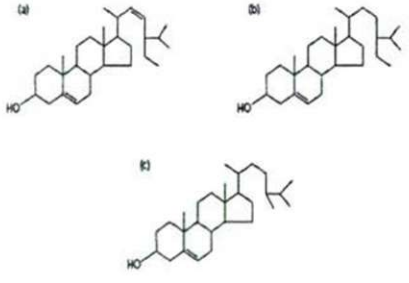


Figure 1. Structures of (a) stigmasterol, (b) β-sitosterol, and (c) campesterol, as main sterols found in plant oils

An important application of sterol fraction analysis is the authenticity determination of olive oils. Specific limits have been assigned to the sterol fraction in olive oil, and if the analysis indicates that the sterol fraction of an oil sample exceeds or fails to meet the limits, the olive oil may have been adulterated with less expensive oil (Hui Y.H., 1996).

The aim of this study was to develop a rapid and convenient chromatographic method for authenticity control of vegetable oils using the total sterol profile determined by gas-chromatography (GC) with flame ionization detector (FID). Two pure oils, rapeseed and olive oil, processed by minimal technologies (cold pressing) and an adulterated olive oil with 30 % of rapeseed oil were used as sample matrices in the method development.

2. MATERIAL AND METHODS

Sampling and Reagents

Two pure, cold pressed vegetable oils, rapeseed and olive oil, and a mixed olive oil with 30 % of rapeseed oil were selected for analysis.

Lipid standards were from Sigma-Aldrich (St. Louis, MO, USA), Merck or Fluka (Buchs, Switzerland). All solvents (analytical-reagent grade or HPLC grade) used were purchased from Merck (Darmstadt, Germany).

Sample preparation for total sterol analysis

The 5α-cholestane-3β-ol (2 mg) was used as internal standard. The oils (1.5 ±0.01 g) were saponified by refluxing in 70 ml of a 1M KOH ethanol/water (8:2, v/v) solution for 1 h. The refluxed mixture was then transferred into a separatory funnel, and the reflux bottle was washed with 10 ml of water. The unsaponifiables, in the combined solution were then extracted two times: firstly with 15 ml of petroleum ether and secondly with 15 ml of diethyl ether. The ether phase was combined, washed three times with 20 ml 5% NaCl solution, and dried with sodium sulfate overnight. The ether phase was filtered into a evaporation bottle and after was evaporated to dryness (using rotavapor). The residue was transferred in a vial with petroleum ether and stored until derivatisation process.

The sterols were derivatized with N,O-bis(trimethylsilyl)trifluoroacetamide (BSTFA) containing 1% of trimethylchlorosilane (TMCS) in pyridine (Piironen V., et al., 2003).

GC-FID analysis

The GC separation of sterol TMS ethers was performed using an Rtx-5 fused silica capillary column (5% phenyl / 95% dimethylpolysiloxane, 30 m x 0.25mm i.d., film thickness 0.25 μm; Restek Corporation, Bellefonte, PA, USA). A SHIMADZU GC-17-A gas-chromatograph equipped with a flame ionization detector (FID) was used. The temperature program was: 5 min at 200 °C, 10 °C / min to 300 °C (hold 20 min).The injection volume was 0.5 μl (split ratio 1:40). The carrier gas was helium.

The identification of sterols was based on comparison of their retention times (R_t) with data from the literature (Phillips K.M. at al, 2005; Kalo P.at al., 2001;). A mixture of sterol standards (sitosterol 95%, campesterol 98%, stigmasterol 95% and sitostanol 96.7%; Sigma Chemical Co) was studied in the same conditions and the retention times (R_t) were used to assist the peak identification. The sterol concentration were calculated using the aria of the internal standard peak.

3. RESULTS AND DISCUSSION

The individual sterol compositions (mg/100g) of the studied two pure vegetable oils (olive and rapeseed) are presented in Fig. 2.

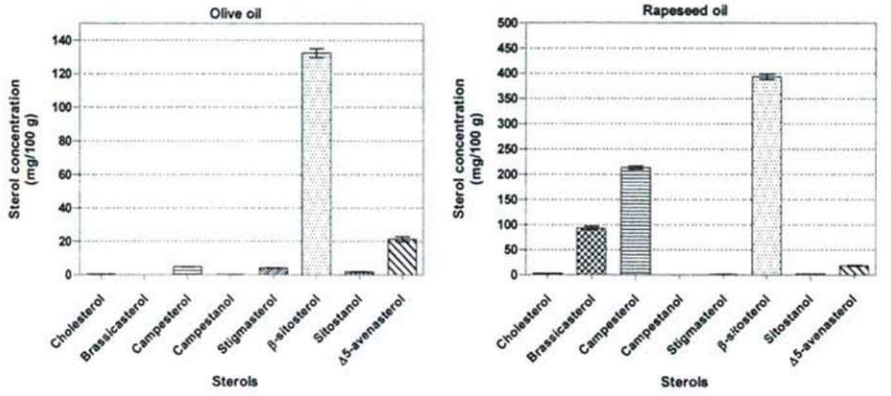


Figure. 2. The individual sterol concentrations (mg/100g) of olive and rapeseed oils

The GC-FID chromatogram obtained after analysis of individual sterols in the adulterated olive oil is presented in Fig. 3.

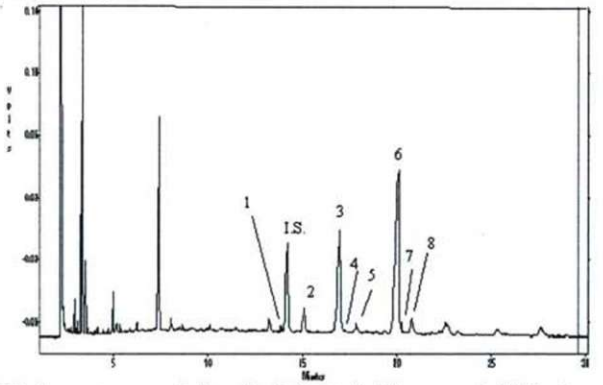


Figure. 3. GC-FID chromatogram of olive oil adulterated with rapeseed oil. Peaks are identified as in Table 1.

The individual sterol composition (mg/100g) of the adulterated olive oil is given in Table 1.

Table 1. Sterols contents (mg/100g oil) in adulterated olive oil (extra virgin olive oil +30% rapeseed oil)

Peak nr.	Phytosterol component	Retention times (Rt)	mg / 100 g oil
I.S.	5α- cholestane-3β- ol	13.751	
1.	Cholesterol	13.680	1.02
2.	Brassicasterol	15.056	21.31
3.	Campesterol	17.061	96.65
4.	Campestanol	17.217	0.60
5.	Stigmasterol	18.526	4.20
6.	β-Sitosterol	20.272	213.23
7.	Sitostanol	20.601	1.96
8.	Δ5-Avenasterol	20.771	20.32
Total sterols			**359.29**

The total sterol content in rapeseed oil was higher (714.55 mg/100g oil) than in olive oil (165.03 mg/100g oil). The rapeseed oil contain higher quantities of β-sitosterol (peak nr. 6), campesterol (peak nr. 3), brassicasterol (peak nr. 2), the ratios (between concentrations) of peaks (6)/ (3) and (3)/ (2) being 1.89 and 2.3 respectively. In extra virgin olive oil the ratios of peaks (6)/ (3) and (3)/ (2) were 27.5 and 4.8 respectively (see Fig.2). After the rapeseed oil was added to olive oil, we observed that the sterol amount in this admixture increased considerable (359.29 mg /100g adulterated olive oil) (Table 1) and the ratios of peaks (6)/ (3) and (3)/ (2) are closer of rapeseed oil.

In the extra virgin olive oil the amount of campesterol was considerable lower (4.60 mg/100 g oil) than in rapeseed oil (212.21 mg/100 g oil). In adulterated olive oil, the amount of this sterol is higher (96.65 mg/100 g adulterated olive oil) than in extra virgin olive oil.

The total sterol profile of olive oil adulterated with rapeseed oil was totally different than the pure olive oil sterol's profile. The presence of the peak nr. 2 (t_R = 15.056), which corresponding to brassicasterol was observed (Fig. 3). So, brassicasterol can be considered a marker for rapeseed oil.

4. CONCLUSIONS

In general, the desmethylsterols (also called sterols) are useful markers to assess authenticity of vegetable oils. Considering that β-sitosterol is the most abundant sterol in the majority of oils, its value has only limited use for the authenticity assessment and differentiation of vegetable oils.

Adulteration of extra virgin olive oil with rapeseed oil can be detected by the presence of brassicasterol. This sterol can be considered the qualitative marker of rapeseed oil, while the concentrations of β-sitosterol, campesterol and brassicasterol as well their ratios can identify the adulteration of virgine olive oil with rapeseed oil. High ratios β-sitosterol/ campesterol are specific to virgin olive oil while these ratios are low for rapeseed oil or adulterated olive oil. Also the ratio campesterol / brassicasterol can indicate the adulteration. Adulterations of olive oil with rapeseed oil determine the decrease of this ratio.

REFERENCES

1. De La Paz M.P., Philen R.M., Borda I.A., Socias J.M.S., De La Camera A.G., Kilbourne E.M., (1996): Toxic oil syndrome: Traceback of the toxic oil and evidence for a point source epidemic. Food Chem. Toxicol. 34 251-257 p.
2. Hui Y.H., (1996): Ed., Bailey's Industrial Oil and Fat Products, Vol. 2, Edible Oil and Fat Products: Oils and Oilseeds (John Wiley & Sons, Inc., New York, 5th ed.,), pp. 257–259 p.
3. Kalo, P. and Kuuranne, T., (2001): Analysis of free and esterified sterols in fats and oils by flash chromatography, gas chromatography and electrospray tandem mass spectrometry, Journal of Chromatography A, 935, 237–248 p.
4. Kamm W., Dionisi F., Hischenhuber C., Engel K.-H., (2001b): Authenticity of fats and oils. Food Rev. Int. 17 249-290 p.
5. Moreda W., (2000): Chromatographic analysis of minor constituents in vegetable oils,(Review), Journal of Chromatography A, 881, 131-148 p.

6. Phillips, K.M., Ruggio, D.M., Khorassani, M.A., (2005): Analysis of steryl glucosides in foods and dietary supplements by solid phase extraction and gas chromatography , Journal of Food Lipids, 12, 124–140 p.
7. Piironen V., Toivo J., Puupponen-Pimia R., Lampi A.-M., (2003): Plant sterols in vegetables, fruits and berries, J Sci Food Agric, 83, p.330–337 p.
8. Tabuenca J.M., (1981): Toxic-allergic syndrome caused by ingestion of rapeseed oil denatured with aniline. Lancet 12, 567-568 p.

SLIDING MODE CONTROL OF PNEUMATIC ARTIFICIAL MUSCLE FOR ROBOT APPLICATION

János Gyeviki, József Sárosi, Tamás Endrődy, Endre Forgács, Antal Véha, Zénó Szabó

Department of Technical and Process Engineering, Faculty of Engineering, University of Szeged, H-6724, Szeged, Mars tér 7, Hungary
e-mail: gyeviki@mk.u-szeged.hu

ABSTRACT

As an important driver element, the pneumatic artificial muscle (PAM) is widely used in industrial applications for many automation purposes thanks to their variety of advantages. The design of a stable robust position controller for PAM is difficult since it is a very nonlinear time-variant controlled plant because of the compressibility of air, air mass flow rate through the valve, etc. The main contribution of this paper is a robust position control method based on sliding mode for a robot arm, driven by pneumatic muscle actuator. Finally, it presents experimental results.

Keywords: Pneumatic artificial muscles, PAMs, sliding mode control.

1. INTRODUCTION

This work is the first fundamental step of a wider project, aimed at studying the humanoid robot. Muscles only generate a force via contraction, i.e. a muscle can only "pull" and does not "push." One muscle (agonist) contracts and simultaneously the other muscle relaxes (antagonist, which increases in length), thus producing a force and motion on the mass. The same effect can be realized in a rotational sense by generating a rotation or torque on the robotic joint through the contraction of the agonist and relaxation of the antagonist muscle.

Many researchers have investigated the precise position control of pneumatic muscles during the past several years. Most of them dealt with the control of single or antagonistic pneumatic muscles.

Due to the fact that the results obtained with a classical PI controller were not good, robust control techniques were considered. For pneumatic muscles, the application of different control techniques is found in the literature, but a good performance requires the use of robust or non-linear control techniques. A variety of approaches, with varying success, have been attempted. PID control, neural networks, and adaptive control, among others, have been utilized [1, 2, 3, 4]. While PID control is well known, the results are particularly sensitive to errors in the feedforward term. Adaptive and neural network control may be more robust, but suffer from slow convergence and long training sessions respectively. Thus, adaptive control is not well suited for the fast movements required of an orthotic actuator. Analogously, neural control, with its training workspace, does not handle unique or unexpected situations well.

Therefore, a non-linear robust control technique, sliding-mode, was applied to design a position controller.

2. MATERIALS AND METHODS

The pneumatic valve is the key element in the system. There are two types of valves used in the pneumatic positioning, servo-valves and on-off valves. With conventional on-off valves accurate position control is difficult to achieve because of the limitation of the valve response time. In the past few years there has been a wide interest in the use of cheap high speed solenoid valves [7]. The most of applications are on pulse with modulation (PWM). By the advent of DSPs with high computation power, the precise and robust control of pneumatic actuators has become possible.

Sliding mode control was introduced in the late 1970's [8] as a control design approach for the control of robotic manipulators. Among experimental studies, a few succeeded in showing closed-loop system behaviour which was predicted by the theory [9].

Another solution is to employ the advanced nonlinear control strategies developed in recent years (soft computing) [10].

The design of a sliding mode controller consists of three main steps. One is the design of the sliding surface, the second step is the design of the control which holds the system trajectory on the sliding surface, and the third and key step is the chattering-free implementation. The purpose of the switching control law is to force the nonlinear plant's state trajectory to this surface and keep on it. When the plant state trajectory is „above" the surface, a feedback path has one gain and a different gain if the trajectory drops „below" the surface.

Consider a single-input, single-output second-order nonlinear dynamic system:

$$\ddot{x} = f(x, \dot{x}, u) \tag{1}$$

Where x is the output signal (position) of the controlled plant, u is the control signal. If x_d denotes the desired value, then the error between the reference and system states may be defined as

$$e = x_d - x. \tag{2}$$

2.1. Sliding surface design

Classically, a scalar variable s is calculated as a linear combination of the error and its derivative.

$$s = e + \lambda \cdot \dot{e} \tag{3}$$

Let $s(\dot{e}, e) = 0$ define the „sliding surface" in the space of the error state. The purpose of sliding mode control law is to force the state trajectory of the error to approach the sliding surface and then move along the sliding surface to the origin (Fig.1.).

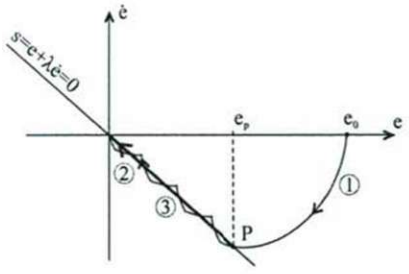


Fig.1. Sliding motion in the state space

The process of sliding mode control can be divided into two phases, that is, the approaching phase with $s(\dot{e},e) \neq 0$ and the sliding phase with $s(\dot{e},e) = 0$. If the system is in sliding mode the error is decreasing exponentially, where λ is a time constant type parameter. If λ is big than the system response is slow but accurate. If it is small than the system response is fast but the system might chatter.

2.2. Selection of the control law

In order to guarantee that the trajectory of the error vector e will translate from approaching phase to sliding phase, the control strategy must satisfy the sliding condition

$$s(\dot{e},e) \cdot \dot{s}(\ddot{e},\dot{e}) < 0. \tag{4}$$

This means that e will always go toward the sliding surface. A proper control should be selected to satisfy the condition (4) in any time instant. The simplest control law that might lead to sliding mode is the relay.

$$u = \delta \cdot sign(s) \tag{5}$$

2.3. Chattering free implementation

Chattering is the main problem of sliding mode control and chattering free implementation is the key step in design of a sliding mode controller. A quite general solution is that the relay (which changes its output value suddenly) is replaced by a saturation function. There is a boundary layer around the sliding surface where the control signal is changing continuously. If the system trajectory is close to the sliding surface and the control signal is small, than the system might stick before the goal.
To avoid it a modified saturation function shown in Table. 1. is proposed. When the limitation of the position is satisfied, all high-speed on-off solenoid valves are ON to stop the overshoot. The control will be finished when $|e_s|$ is smaller than e.

3. THE SERVOPNEUMATIC POSITIONING SYSTEM

The experimental set-up, is shown in Fig.2. Fig.3. and Fig.4. consists of a slider mechanism. One side of the muscle is fixed to a load cell, while the other side is attached to the movable frame. The load cell (7923 type from MOM) is a 4 bridge element of strain gauges. It is mounted inline to the PAM on the fixed surface. The load cell measures the force exerted by the PAM. The linear displacement of the actuator is measured using a LINIMIK MSA 320 type linear incremental encoder. Velocity and acceleration are obtained by numerical derivation. During each test, slider position, muscle force and applied gauge pressure are recorded. Since PAMs are one-way acting, two are needed to generate bidirectional motion: as one of them moves the load, the other one will act as a brake to stop the load at its desired position. To move the load in the opposite direction the muscles change function. The PAMs were installed horizontally such that the only force present during activation was the small friction force of the slider mechanism. In the test-bed, two DMSP-20-200N-RM-RM type fluidic muscle (from FESTO) can controlled by tree-way and two-way solenoid valves (MATRIX HX 751.102 C 324 3/2 NC and PX 861.9E4C2KK fast switching types in Fig. 3.) and a proportional valve (FESTO MPYE-5-M5-HF-010-B type. in Fig. 4.).

We repeated experiments for several levels of pressures in the range from 0 to 5 bar. To measure the air pressure, two Motorola MPX5999D pressure sensors were plumbed into the pneumatic circuit. A National Instruments data acquisition card (NI 6251/M) reads the signal of force, pressure sensors and incremental encoder into the PC. National Instruments LabVIEW will be used to monitor and collect the data imported through the DAQ card. It will also dispatch the control profiles for the PAMs.

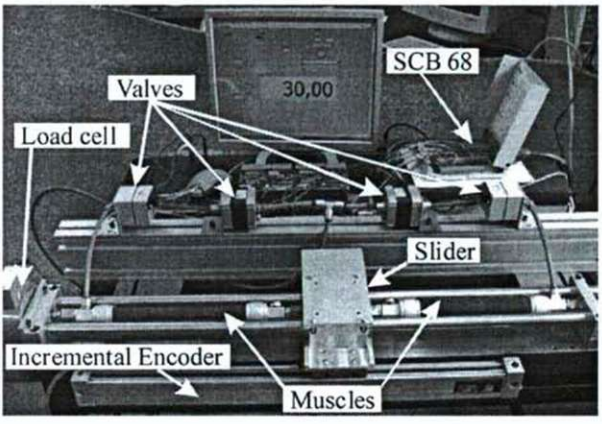


Fig. 2. The photo of the experimental setup

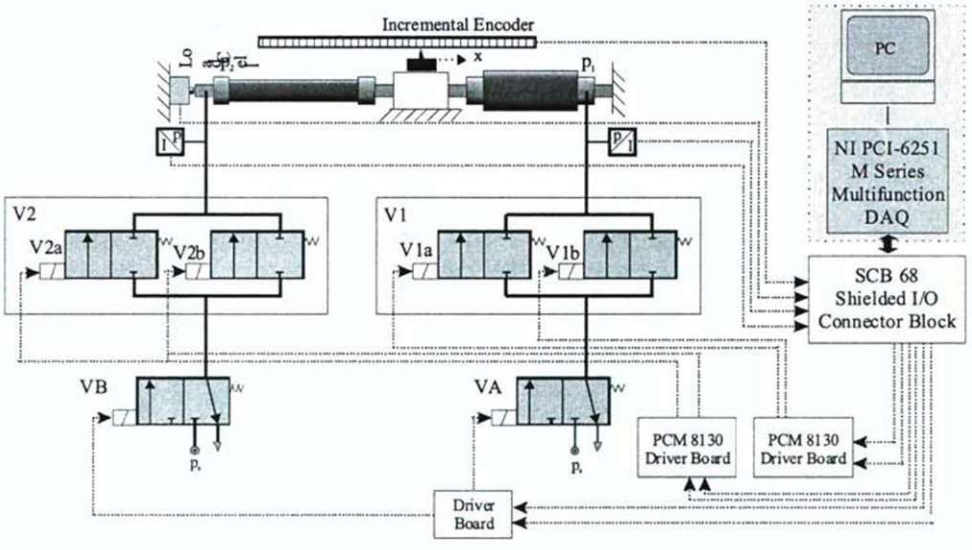


Fig. 3. Configuration of pneumatic positioning system with on-off valves

The system pressure is set to be 6 bar, the sampling time is 10 ms. In order to analyze the positioning methods a real-time data acquisition program was designed. The control program is based on Table1.

Table 1.

		Fast Forward	Slow Forward	In Position	Slow Backward	Fast Backward
VA		1	1	1	0	0
VB		0	0	1	1	1
V1	V1a	1	1	0	1	1
	V1b	1	0	0	0	1
V2	V2a	1	1	0	1	1
	V2b	1	0	0	0	1

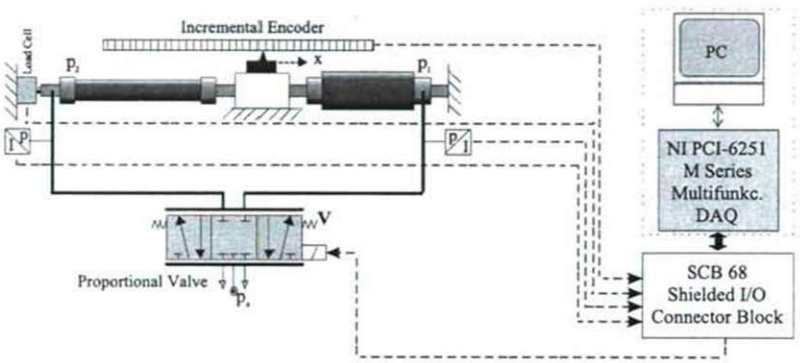


Fig. 4. Configuration of pneumatic positioning system with proportional valve

4. EXPERIMENTAL RESULT

The conventional, single stage solenoid operated on–off valves are very bulky and their dynamic performances are low. With these valves fine motion control is difficult to achieve because of the limitation of the valve response time. With on-off control the system will never reach a steady state value.
The actual position will tend to oscillate around the desired position. The second measurement is a positioning with high-speed on-off solenoid valves. The time functions of the position, and control signal is shown Fig.5. and Fig.6. The position error of the LabVIEW-based relay type sliding mode control is within ±0.02 mm.
This behavior is in absolute contrast to that of a pneumatic cylinder: a cylinder develops a force which depends only on the pressure and the piston surface area so that at a constant pressure, it will be constant regardless of the displacement.

5. CONCLUSIONS AND FUTURE WORKS

This work is the first fundamental step of a wider project aimed at studying the PAMs. With the help of this test-bed we can carried out several static and dynamic investigations and control methods. Based on the laboratory measurements we can conclude that the pneumatic servo-systems can be used for precise robust position control. The sliding mode

control is a promising tool for controlling such systems. The proposed modified saturation function can eliminate the chattering, which is the main problem in case of sliding mode control.

Further works we have done with applying the input shaping method. Once the system has reached the setpoint, the residual oscillation will degrade positioning accuracy and may cause a delay in task completion. Input Shaping is a feedforward control technique for reducing vibrations in computer controlled machines. The method works by creating a command signal that cancels its own vibration. That is, vibration caused by the first part of the command signal is canceled by vibration caused by the second part of the command. Input shaping is a command generation technique that is used to reduce command-induced vibration (as opposed to disturbance-induced vibration) [11]. Input shaping is implemented by convolving a sequence of impulses, called an input shaper.

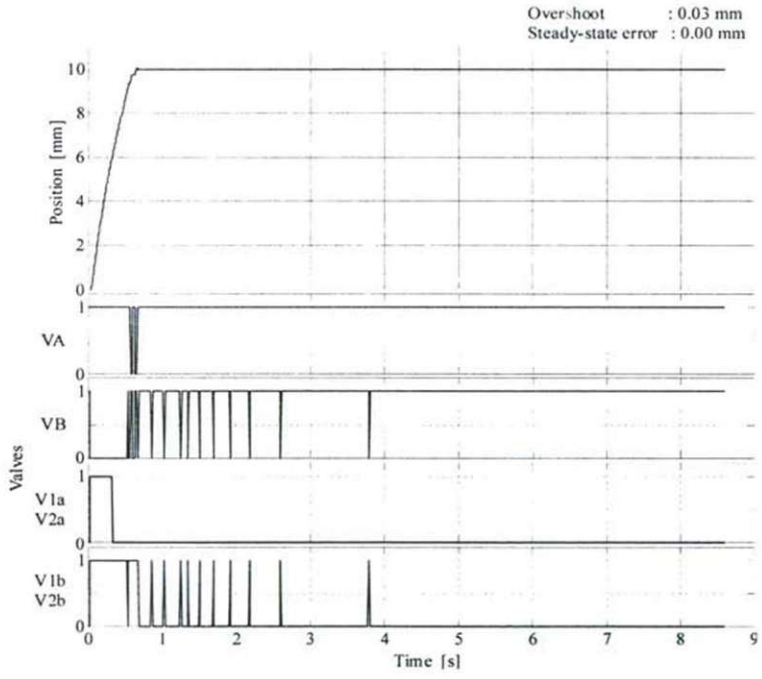


Fig. 5. The time functions of the position and control signal

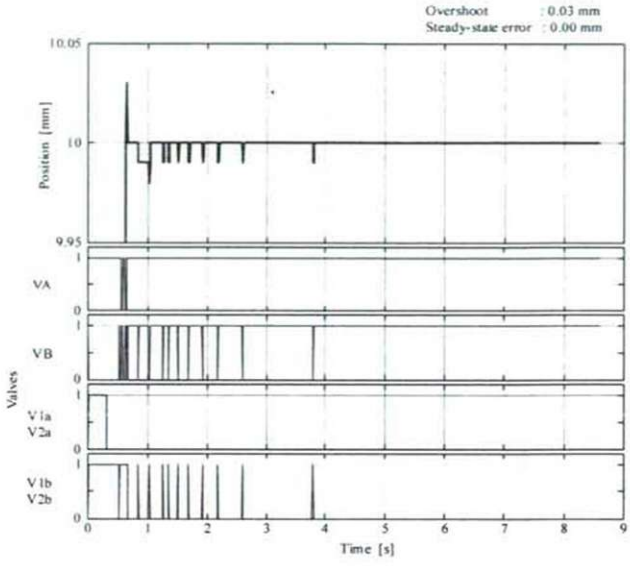


Fig. 6. The time functions of the position and control signal (enlarged)

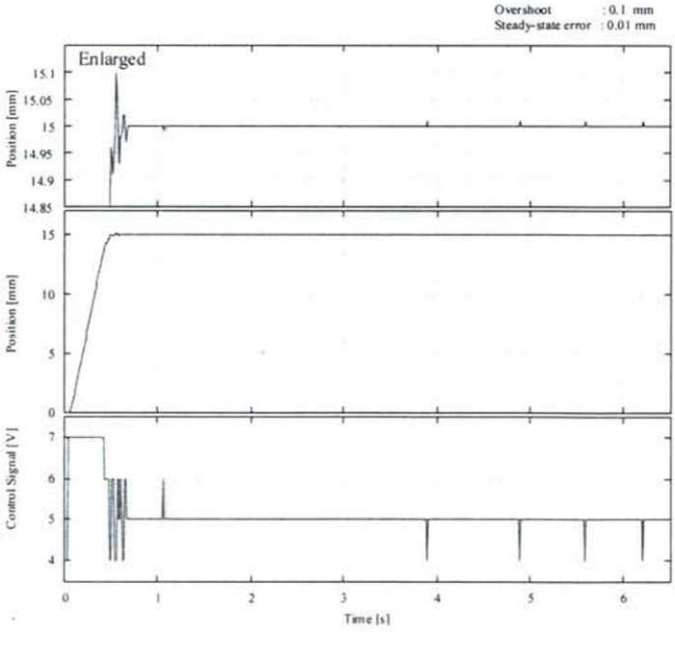


Fig. 7. The time functions of the position and control signal (with proportional valve)

REFERENCES

1. T. Hesselroth, K. Sarkar, and K. S. Patrik van der Smagt (Jan. 1994): Neural network control of a pneumatic robot arm," IEEE Transactions on Systems, Man, and Cybernetics, vol. 24, no. 1, pp. 28-38.
2. D. Caldwell, G. Medrano-Cerda, and M. Goodwin (Oct. 1993): Braided pneumatic actuator control of a multi-jointed manipulator," in Proceedings of the 1993 International Conference on Systems, Man, and Cybernetics, vol.1., pp. 423-428.
3. Caldwell, D.G et al.(Feb. 1995): Control of Pneumatic Muscle Actuator, IEEE Control Systems Mag. pp. 40-48.
4. G. Medrano-Cerda, C. Bowler, and D. Caldwell (Aug. 1995): Adaptive position control of antagonistic pneumatic muscle actuators," in IEEE/RSJ International Conference on Intelligent Robots and Systems, vol. 1, pp. 378-383.
5. B. Tondu and P. Lopez (Apr. 2000): Modeling and control of McKibben artiffcial muscle robot actuators," IEEE Control Systems Magazine, vol. 20, no. 2, pp. 15-38.
6. Frank Daerden (1999): Conception and Realization of Pleated Pneumatic Artificial Muscles and their Use as Compliant Actuation Elements. Dissertation Vrije Universiteit Brussel.
7. M.C.Shih, M.A.Ma (1998): "Position Control of a Pneumatic Rodless Cylinder Using Sliding Mode M-D-PWM Control the High Speed Solenoid Valves" JSME International Journal Series C, Vol. 41, No.2, pp.236-241.
8. V.Utkin (1977): "Variable Structure Systems with Sliding Mode" IEEE Trans. vol. AC-22, No.2, pp. 212-222.
9. P.Korondi, H.Hashimoto (2000): "Sliding Mode Design for Motion Control" (12 pages) Studies in Applied Electromagnetics and Mechanics vol. 16. ISBN 90 5199 487 7, IOS Press.
10. Gy. Mester (1995): "Neuro-Fuzzy-Genetic Controller Design for Robot Manipulators." Proc. IECON'95, IEEE, Orlando, Florida,USA,Vol.1.pp.87-92.
11. William Singhose, Erika Biediger, Ye-Hwa Chen, and Bart Mills (2004): "Reference command shaping using specified-negative-amplitude input shapers for vibration reduction." ASME J. of Dynamic Systems, Measurement, and Controls.

HACCP SYSTEM IN FOOD TRADE WHY AND HOW?

*László Hegedüs**
College of Nyíregyháza, Faculty of Economics and Social Studies,
Department of Logistics and Project Management
H-4400 Nyíregyháza, Sóstói u. 31.
e-mail: hegedusl@nyf.hu

ABSTRACT

The purpose is to adopt the operation of HACCP to the hierarchy of the company, and to test the CCP selection mode within HACCP that excludes errors. The result is the presentation of the target hierarchy containing the HACCP system, and of the objective CCP selection method.

1. INTRODUCTION

- Why do food trade enterprises need the HACCP system?

The endangerment in connection with comestible safety has entered a new dimension nowadays, as risk became global, while food chain became more complicated and harder to trace. (Szeitzné 2009).
The creation and maintenance of food safety is compulsory in the whole food chain, which is permitted by the operation of the identification and tracing as well as the HACCP and/or ISO 22000 and/or IFS systems – in the whole food chain (Sósné 2008, Balla-Síró 2007).

If the safety of the food is broken in any unit of the food chain, then it cannot be restored in the remaining units of the chain, and if it happens in food trade, then the efforts of the other units in the chain were spare. This is why the often stressed point of food trade - saying only the manufacturer is responsible for the safety of the food - is incorrect. This theme has to be amended with "...except the error was caused by someone else by not complying with the storage conditions suggested by the manufacturer" (Deák 2009). As the contamination endangering the health of the consumers can issue anywhere within the food chain (Szeitzné Sz. M. 2008). The affected trade enterprises suggest their partners by stressing out the obligate responsibility of the manufacturer that they have nothing to do with this case, they don't have to deal with protecting the supplied safe food from (microbiological, physical, etc.) contamination, or maintaining its safe state, etc. This kind of behavior may result in food safety systems existing only formally, their operation will not be adopted to the projects of trade companies, thus will not approve of achieving the strategy of the company.

- How to establish HACCP in food trade enterprises?

The steps of the configuration of HACCP system are reviewed by the no. 1-2-18/1993 regulation of the Hungarian Food Book. According to this most of the cases the significant dangers in food are defined by the "decision tree" method (Győri-Győriné 2002).

It's obvious that truly "critical" point of establishing a food safety system is the selection of CCP-s (Sósné 2002). Because if they are identified incorrectly then irrelevant, less dangerous points can get into the centre of attention, and the truly dangerous points will not be supervised. And if the negative change of condition affecting food safety might appear, then we will be unprepared and will not be able to encroach at once to solve the problem.

Besides the "decision tree" method I looked for an alternate method and I also tried it. According to my hypothesis CCP-s chosen by the two methods do not completely match, thus if the CCP-s are selected incorrectly then important dangerous points can fall out of control. As a result even dangerous food can reach consumers.

2. MATERIAL AND METHOD

- For the support of the necessity of HACCP:

For the support of the necessity of HACCP I had compiled the target hierarchy of food trade enterprises and inserted – after considering – the establishment and operation of HACCP system in it.

- For defining CCP-s while configuring the HACCP system:

Hence during my work – as an experiment – I defined the critical points in the activity of a food trade enterprise by two methods, and compared the results.
- One of the methods was based on the usage of the "decision tree", which means that the critical points of the process have been defined empirically, through a consensus between the members of the HACCP team.
- The other method is the objective method based on lab examinations, which can define critical points without doubt. The lab examinations were performed according to the methods listed in the 3rd book of the "Hungarian Food Book: The Official Collection of Methods for the Examination of Food" (2005).
This was followed by the comparison of the results by the two methods, which showed that there may be significant differences concerning CCP-s.

The first steps of the configuration of HACCP system are demonstrated on figure 1.

3. RESULTS AND DISCUSSION

- The support of the necessity of HACCP:

The first step for the board of food trade enterprises is the creation of the target hierarchy, namely processing the strategy and future plans of the company and then defining and achieving projects for their achievement.
Establishment and operation of the HACCP system is important amongst the projects.

The target hierarchy helps visualize the purpose and place of the food safety (quality improvement) system in the achievement of short term and long term targets of the food

trade enterprise. It helps understanding that establishment and operation of HACCP (TQM, etc.) systems has to be achieved as a project. This approach is presented on Figure 2.

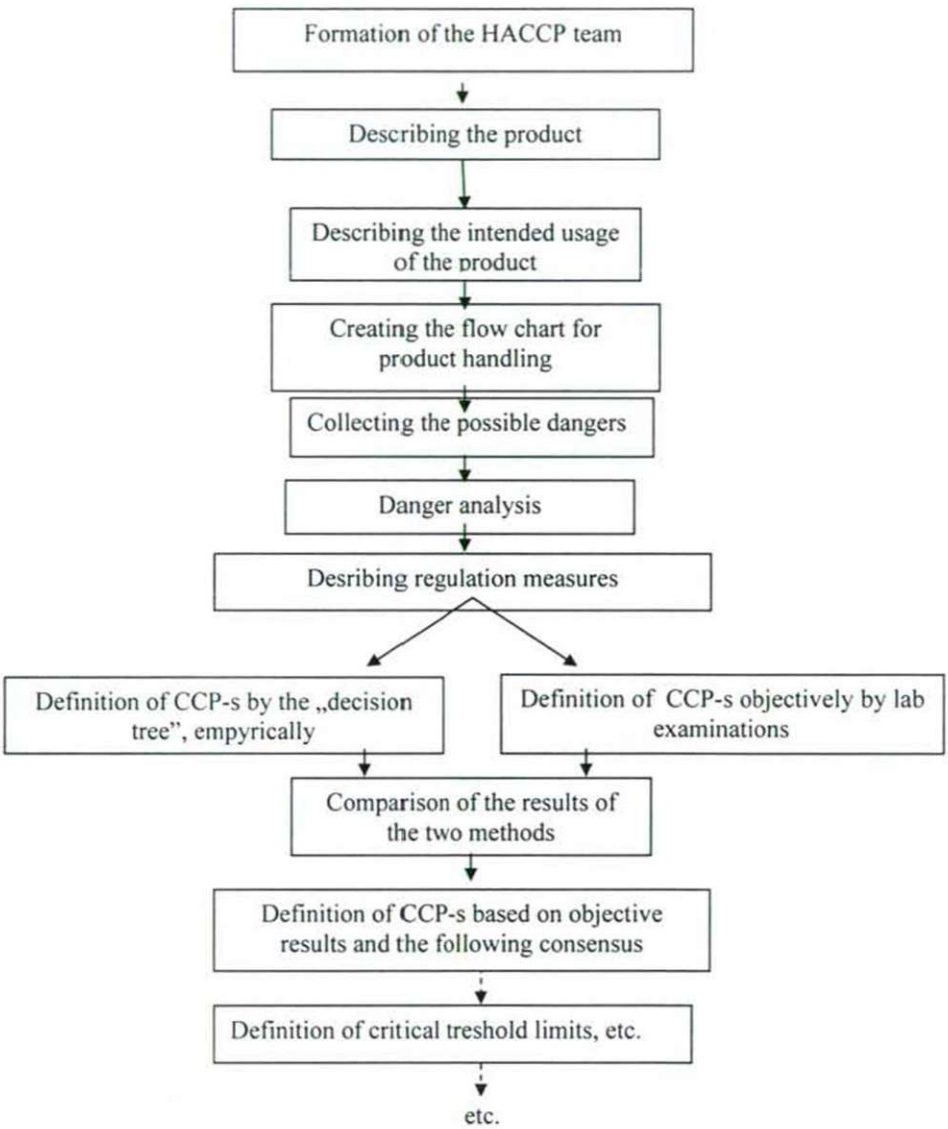


Figure 1. The first steps of the configuration of HACCP system

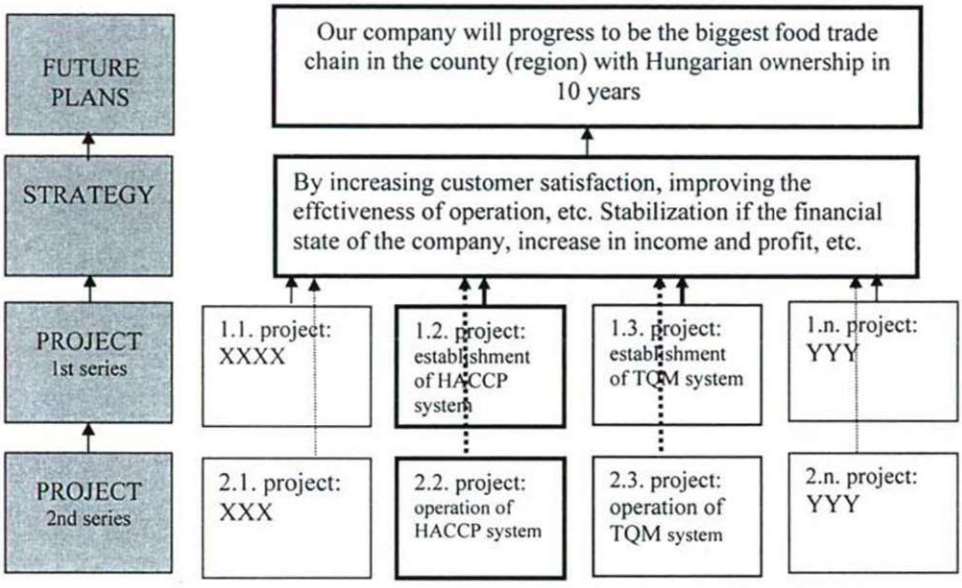


Figure 2. Example of the target hierarchy of a trade enterprise

Studying the figure can help the leaders and employees of the company realize the necessity of the establishment of HACCP (TQM, etc.) systems, and the meaning of the importance of their operation. To realize that these systems can only be operated with a project approach, thus applying HACCP (TQM, etc.) can be a project every year. This means that we have to set the aim of thei operation every year, and provide recources for them. The aim has to be set every year in a way that it should progress towards achieving the strategy.

Thus in the first series of projects (eg. in the 1st year) the aim is the processing and establishment of the systems, while in the second series of projects (eg. in the 2nd year) the operation of the systems means the project.
The aim of operation – e.g. in case of the HACCP system – can be:
- Increasing the safety of the food – for the sake of customer satisfaction – by processing a control system for dealers, by processing and introducing taking the products from a food safety point of view.

As a closure of the project the rate of reaching the targets is estimated. Then the aims, projects, etc. are selected for the next year.

- For defining CCP-s upon establishing the HACCP system:

The results of defining the critical points by two methods differ from each other, which is presented through the process of retail handling of "Loose culinary and confectioner products" product group. (This product group contains the following: various culinary products not in unique retail wrappings, confectioneries requiring and not requiring cooling, etc.)

I had performed microbiological examinations in every steps of the process. The selection of microorganisms to be examined and valuing the results were performed according to 4/1998. (XI.11.) EüM. order. The comparison of the results by the two methods are presented in Table 1.

Table 1. Comparison of the two CCP definition methods

No. of step	Name of procedure	CCP-s (defined by the usage of the "decision tree", in teamwork)	CCP-s (defined by microbiological laboratory examinations)
Treshold level [according to 4/1998. (XI.11.) EüM. order]			
1.	Purchase		
2.	Transport (with own equipment)		X
3.	Taking over the product		
4.	Storage	X	X
5.	Unloading in the shop and reloading in the depository		
6.	Storage in shop		X
7.	Standard marketing		
8.	Self-service marketing		
9.	Pre-packing	X	

As the last two columns of the table show, although the CCP list defined by two methods matches in certain cases, there is a often a difference between CCP-s defined empirically in teamwork, and CCP-s defined by laboratory calculations (based on objective data).

This means a serious problem concerning attention, regulation, control, etc. turns towards the occasionally incorrectly defined CCP-s and not towards truly critical procedure steps. As a result food safety dangers on the critical points not recognised by the traditional method can "unperturbedly" harm the health of the consumers, and decrease the trust of the customers.

4. CONCLUSIONS

Inserting the establishment and operation of the HACCP food safety system in the target hierarchy of the food trade enterprise the necessity of the system becomes visible for the management and coworkers of the company. Project oriented establishment and operation of the system helps achieving the strategy.
The most critical point in the establishment of the HACCP system is selecting the CCP-s, thus besides or instead of using the "decision tree" basing the definition of CCP-s on objective calculations is (also) suggested. As a result of this method, the attention can be turned towards those steps of food handling processes, that can seriously endanger the safety of food.

REFERENCES

1. Balla Cs., Síró I. szerk. (2007): Élelmiszer-biztonság és –minőség II., Mezőgazda. 93-105. p.
2. Dr. Deák Ferenc (2009): Az új élelmiszerlánc felügyelet szabályozása. Sütőiparosok, pékek. LVI évf. 1. szám. 28-32. p.
3. Győri Z. - Győriné M.I. (2002): Minőségrendszerek bevezetésének és alkalmazásának tapasztalatai növényitermék előállításban. Magyar Minőség. 11. sz. 21-25. p.
4. Magyar Élelmiszerkönyv I. 1-2-18/1993. sz. előírása: A Veszélyelemzés, Kritikus Szabályozási Pontok (HACCP) rendszerének alkalmazása. (1998).
5. Magyar Élelmiszerkönyv III. Hivatalos Élelmiszervizsgálati Módszergyűjtemény. (2005).
6. Sósné Dr. Gazdag Mária (2008): Jogszabályi megfelelőség és különböző élelmiszerbiztonsági rendszerek követelményei. Konzervújság. 1-2. szám. 18-23. p.
7. Sósné G. M. (2002): A HACCP élelmiszerbiztonsági rendszer gyakorlati alkalmazása In: Győri Z. szerk.: Minőségirányítás az élelmiszergazdaságban 125-139. p.
8. Szeitzné Sz. M., Krisztalovics K., Sréterné L. Zs., Fehér Á., Cseh J. (2008): Magyar-ország mikrobiológiai élelmiszerbiztonsági helyzete. ÉVIKE Különszám. 7-11. p.
9. Szeitzné Sz. M. (2009): Gondolatok a globális élelmiszerbiztonságról. Élelmezési Ipar. LXIII. évf. 2. szám. 51-52. p.
10. 4/1998. (XI.11.) EüM. rendelet az élelmiszerekben előforduló mikrobiológiai szennyeződések megengedhető mértékéről.

REGIONAL BIASES OF RESEARCH AND DEVELOPMENT IN HUNGARY

Gabriella Keczer
University of Szeged, Faculty of Engineering

ABSTRACT

Research, development and innovation are very important drivers of regional development in knowledge-based societies. But R&D staff and expenditure show significant regional differences in Hungary and in the European Union as well. In Hungary 60% of staff and expenditure are concentrated in the capital, and the gap between Budapest and the rest of the country is not closing. This is a problem for those regions that are left out from the knowledge-based development, but also a drawback for the country as a whole. In my paper I analyze the regional biases of research and development in Hungary on the basis of statistical data, and summarize the consequences of these differences.

1. INTRODUCTION

Research and development (R+D) trigger progress and competitiveness both in countries and in particular regions of countries with knowledge-based economies. This, however, becomes effective on a nationwide scale provided R+D capacity and activity are not concentrated in a single region but are distributed among a number of scientific centers with distinction which promote the hosting of innovative enterprises and development based on the application of expertise and/or the production of competence within the region concerned.

Statistics shows, however, that research development in Hungary – that is, the number of researchers –, the budget for R+D and, also, scientific impact are marked by Budapest-centeredness while in regions outside the Capital there is considerable research activity only in counties hosting universities.

In this paper I am considering the limited role localities, counties and regions play in the politics of innovation. I am analyzing the distribution of research staff, R+D budgeting and scientific performance, and, then, summarize the negative effects resulting from regional inequalities.

2. THE ROLE OF LOCALITIES, COUNTIES AND REGIONS IN INNOVATION POLITICS

The country report issued by the European Union, monitoring our country, states that innovation politics reflects the fact that Hungary is basically operated centrally. Though – mainly due to external pressure by the Union – lower levels of innovation politics have been gathering more and more choices to participate, the key-role of Budapest and that of the central government and its agencies has been remaining unchallenged.

As far as the level of local administration is concerned local governments have been having difficulties in providing many services (education, health service, public

services, the maintenance of infrastructure, etc.) while financial resources are provided mainly by the central administration's budget due to the essentially redistributive nature of the budgeting system instead of letting local governments operate on a basis of an income of their own. Central financing is, on the other hand, operated by short-term fiscal considerations which situate numerous local administrations in rather an uncomfortable financial position. In such circumstances – with the exception of some larger towns – it is entirely impossible to finance local R+D activities. Local governments are not able to have immediate influence in the field e.g. via setting up industrial parks, providing allowances in taxation for possible innovative enterprises moving to the locality.

Neither does county-level administration play an important role in innovation politics because in spite of the fact that R+D protocols are passed by county boards of development these programs are designed in view of preferences issued by the Economic Competitiveness Program and by the Fund for Research in Technological Innovation (KTIA) and budgeting is operated under their auspices.

As far as the regional level is concerned there are no regional boards for innovation in Hungary due to the centralized system of institutional R+D activities. Each of the 7 regions has set up a regional strategy in innovation (as part of the general regional development strategy but regions are in a position akin to that of the counties: the various regional development programs are generally related to national programs and to that of the European Union, and, are based on such budgets. Consequently, there are no such things as independent R+D plans. Although 25% of KTIA finances regional programs and the national Baross Gábor Project is also to promote the establishing of regional innovation networks, the decisions relating to them are made by the Board for Research and Technological Innovation instead of regional boards. (EU, 2007)

3. REGIONAL BIAS IN THE NUMBER OF RESARCHERS

More than half of the number of R+D researchers is concentrated in the area of Central Hungary, i.e., the number of researchers in the rest of the 6 regions is smaller than the number of researchers working in the Capital (Table 1).

Table 1. The distribution of researchers in the 7 regions in 2007.

	Number of R+D researchers	Share within the overall R+D staff in Hungary
Central Hungary	16 273	63 %
South–East Hungary	2 203	8%
North-East Hungary	2 018	8%
South-West Hungary	1 628	6%
Mid-West Hungary	1 429	6%
West Hungary	1 268	5%
North Hungary	1 152	4%

Source: KSH (2008), own compilation

Oddly enough, the bias between the number of central and "country" researchers has not decreased (Table 2) [Hungary shaped the system of European statistic regions {NUTS level 2} in 2000 and regional data have been available since then].

Table 2. The Number of researchers in the seven regions of Hungary, 2000-2007.

	Central Hung.	South-East	North-East	South-West	Mid-West	West Hungary	North Hungary
2000	15 131	2 170	1 991	1 067	1 463	948	764
2001	14 680	2 129	1 777	1 053	1 304	1 159	840
2002	15 136	2 156	1 973	965	1 294	1 084	1 095
2003	15 124	2 099	1 909	1 064	1 139	1 020	956
2004	14 741	1 910	1 763	1 244	1 206	895	1 067
2005	14 740	2 126	1 946	1 342	1 158	966	961
2006	16 273	2 203	2 018	1 628	1 429	1 268	1 152
2007	16 252	2 401	2 417	1 066	1 417	1 246	1 155

Source: KSH (2000-2007).

The analysis of the indicators of countries reveals that there is no doubt, besides the Capital, scientific activity, is mostly located in regions with larger universities run by the state and with research institutes belonging to the Academy (in bold type, Table 3).

Table 3. The number of research sites in the counties of the 7 regions in 2007.

REGIONS AND THEIR COUNTIES	RESEARCH SITES
Central Hungary	
Budapest	**1 119**
Pest	175
Mid-West	
Veszprém County	**84**
Fejér County	75
Komárom-Esztergom C.	27
West Hungary	
Győr-Moson-Sopron C.	**122**
Vas County	61
Zala County	33
South-West	
Baranya County	**180**
Tolna County	14

Somogy County	52
North Hungary	
Borsod-Abauj-Zemplén County	**102**
Heves County	60
Nógrád County	11
North-East Hungary	
Hajdú-Bihar County	**224**
Szabolcs-Szatmár-Bereg County	76
Jász-Nagykun-Szolnok C.	35
South-East Hungary	
Csongrád County	**207**
Bács-Kiskun County	72
Békés County	31

Source KSH (2008), own compilation

4. MAGNITUDE OF BIASED R+D BUDGETING

R+D budgeting and the number of researchers are biased in a similar way. The region in which Budapest is located receives 70% of the country's overall research and development finances while the rest has to make do with 30% (Table 4).

Table 4. Finances in the 7 regions of Hungary in 2007.

	R+D finances 1.000HUF	R+D finances %
Central Hungary	163 076 197	70%
North-East	18 113 418	8%
South-East	16 941 277	7%
Mid-West	11 336 808	5%
West Hungary	9 431 258	4%
North Hungary	7 362 934	3 %
South-West	6 926 078	3%

Source: KSH (2008), own compilation

The biased distribution of R+D budgeting between the Capital and the Country has not been leveled during the past couple of years at all (Table 5).

Table 5. R+D expenses/year in the 7 regions of Hungary, 2000-2007.

	Central H.	N-East	S-East	Central-W.	West H.	North H.	South-W.
2000	69 166 434	8 035 683	7 844 468	5 223 863	2 915 992	2 428 885	3 892 687
2001	88 262 705	9 109 756	9 195 809	7 914 511	7 006 992	2 836 299	4 630 235
2002	111 346 304	11 181 656	11 941 673	10 398 436	5 676 675	3 897 451	5 848 959
2003	115 130 505	13 073 449	13 047 556	9 775 062	6 261 023	4 121 068	5 220 114
2004	116 692 151	14 760 749	11 895 667	10 820 468	8 224 735	4 729 254	5 773 000
2005	138 789 817	17 913 272	14 658 234	9 673 362	6 736 572	5 890 267	6 458 542
2006	163 076 197	18 113 418	16 941 277	11 336 808	9 431 258	7 362 934	6 926 078
2007	158 761 218	20 446 096	18 983 122	12 916 380	14 818 976	8 372 796	6 072 343

Source: KSH (2008).

The majority of R+D expenses has been provided (*in lack of significant enterprise operated research and development activities* – G.K.) by central resources. This way administrational budgetary politics has been maintaining a solid concentration within the Capital and the inequalities remain the way they always have been. Most of these resources have been used by state universities and, consequently, inequalities within regions have also stayed (Lengyel, 2003).

If R+D finances are mapped onto the population the privileged status of Central Hungary becomes even more highlighted. Here, in the Central Region, R+D finances/inhabitant is 2.4 times more than the national average. The advantage enjoyed by the central region is significantly bigger than the extent its share in higher education or its economic performance would indicate since the number of full time students in the region of Central Hungary and the GDP/person is only 1.6-1.7 times more than the national average (KSH, 2008).

5. DISPARITIES OF SCIENTIFIC PERFORMANCE

It is a fact that scientific performance (successfully completed research projects, experimental developmental projects) has also shown significant concentration. But, on the other hand, the difference between the Capital and the Country is much smaller than the difference between the numbers of researchers and the two R+D budgets (Table 6).

Table 6. Successfully completed research projects, experimental developmental projects in the 7 regions of Hungary in 2007.

	Successfully completed research projects, experimental developmental projects (/item)	Successfully completed research projects, experimental developmental projects (%)
Central Hungary	4 647	54%
North Hungary	934	11%
West Hungary	815	10%
South-East	750	9%
North-East	645	8%
Mid-West	484	6%
South-West	260	3%

Source: KSH (2008), own compilation

This table shows that the efficiency of input and research staff is lower at sites located in Budapest than in the scientific centers in the Country. Budapest receives 70% of the overall input while produces just a bit more than half of the scientific performance. In the South-East Region research performance is 3 times more than the proportion of input, and in the West Hungary Region it is 2 and a half times more.

6. CONSEQUENCES

Disproportionate regional R+D activities are dangerous because, within a region, primarily, effective R+D programming would gear an enduring increase in competitiveness (Lengyel, 2003). Capacities at hand within the academic and higher educational centers in the country provide the chance of a more rapid development and they, at the same time, offer more favorable conditions for the reordering of local and regional economy (Hardi, Rechnitzer, 2003). But in counties in lack of academic and university research plants (that is, in the majority of the counties) there is no chance for innovative enterprises to settle because neither conditions in human resources nor institutions of innovation have been provided for this. "International data suffice to say that within underdeveloped regions, due to the lack of transferred technology, a dynamic increase in performance is unlikely to occur. Consequently, in these regions economic development also continues to grow slowly. They cannot switch from a factor-oriented phase onto an investment-oriented one, from the Neo-Fordite phase to a knowledge-extensive one. So incomes and the standard of living will remain low." (Lengyel 2003)

The concentration of research capacity is problematic on a nationwide level because the potential of academic centers in the country has not yet reached the critical mass that might do for the basis of a knowledge-based economy. An economy based on Budapest-centeredness can hardly increase the country's performance any further (Gál 2005, Gál 2006).

7. ASSESSMENT

In knowledge-based economies research and development trigger the development and competitiveness of a country, and, within the country, that of its regions. Statistical data reveal, however, that research-developmental activities, the number of researchers, R+D input finances and scientific output have been marked by permanent Budapest-centeredness; while, besides the Capital, there are significant scientific activities solely in counties hosting universities.

Regions have not been leveled conspicuously since the change in the political regime, on the contrary: new types of inequalities have developed. New episteme has accumulated in definitive concentration in the Capital and, to a lesser extent, in regional centers and this will be dispersing to lower levels of localities slowly, at a modest speed – one might say, surreptitiously –, in some cases, randomly (Rechnitzer, Smahó, 2005).

The scientific "hydrocephaly" of the country has a number of detrimental consequences, which hinder progress both on a national and on a regional level.

- The scientific potential in towns hosting universities in the country has not reached the critical mass that could provide a sufficient basis for the development of a knowledge-based regional economy.
- A single center is unable to provide the scientific output that would make a paradigmatic change in the national economy promoting innovation and value-added assessment viable.
- Regions with hardly any research potential may have no chance to welcome enterprises of innovation. Development and the standard of life in these areas that have been doomed to stay on the periphery, consequently, will be remaining permanently low.

8. CONCLUSION

R+D capacity and activities ought to be extended in Hungary for the sake of national and regional development. The strategy that has been issued by the government has put it this way: a strategy based on innovation should be one of the definitive segments of the strategy of regional development. With the strengthening of innovation potential within poles of development the regional imbalances of a nationwide system of innovation ought to be moderated. Integrated professional centers, technology-transfer centers and centers for innovation must be set up in each region and they will be the region's intellectual R+D+I centers (MEH, 2007).

The fact that scientific activities carried out in the central region are less effective than those that are going on in the country would definitely indicate that the research potential situated in the country should be developed.

At the same time, the regional structure of higher education should be modified in order to let at least the significant university centers in the country increase their size and impact so as to match the standard of European average, and to reach the critical mass in research potential at the level of which they will be able to become the bases of a knowledge-based economic development.

BIBLIOGRAPHY

1. Gál József (2006): Gondolatok a nemzetközi vándorlás és a tudásáramlás logisztikai értelmezéséről, Agrár- és vidékfejlesztési szemle, 1. évf. 1. szám SZTE MGK, Hódmezővásárhely, vol. 2006/1, pp. 75-79.
2. Gál Zoltán (2005): Az egyetemek szerepe a regionális innovációs hálózatokban. In: Tudásmenedzsment és tudásalapú gazdaságfejlesztés. JATEPress, Szeged.
3. Hardi Tamás, Rechnitzer János (eds.) (2003): A Széchenyi István Egyetem hatása a régió fejlődésére. Széchenyi István Egyetem Tudományos Füzetek, vol. 5. Győr.
4. Horváth Gyula (2003): Egyetem és regionális átalakulás. In: Város és egyeteme. PTE, Pécs.
5. Lengyel Imre (2003): Verseny és területi fejlődés. JATEPress, Szeged.
6. Rechnitzer János, Smahó Melinda (2005): A humán erőforrások sajátosságai az átmenetben, MTA Közgazdaságtudományi Intézet, Budapest.
7. EU (2007): INNO-Policy TrendChart - Policy Trends and Appraisal Report, Hungary. www.eu.org
8. KSH (2000-2007): Kutatás-fejlesztés Magyarországon – éves jelentések. www.ksh.hu
9. KSH (2008): A gazdasági fejlődés regionális különbségei Magyarországon 2007-ben. www.ksh.hu
10. MEH (2007): A Kormány középtávú (2007-2013) tudomány-, technológia és innováció-politikai stratégiája. www.meh.hu

DEVELOPMENT OF AN ENERGETICALLY-BASED CONTROL FOR SOLAR THERMAL HEATING SYSTEMS

Richárd Kicsiny
Department of Physics and Process Control, Faculty of Mechanical Engineering,
Szent István University, H-2103, Gödöllő, Páter K. u. 1, Hungary
e-mail: Kicsiny.Richard@gek.szie.hu

ABSTRACT

This paper introduces the realization and application of a physically-based mathematical model of solar heating systems. The model was realized in TRNSYS 16 simulation environment which is well recognized and frequently-used in scientific researches of transient thermal processes. The model is flexible that is it can be easily adapted to a wide range of particular solar heating systems and is a good tool for analyzing and developing them. As an application the model was adopted to the particular solar heating system at the campus of Szent István University, Gödöllő and a new, energetically-based control was evolved and compared with the generally used on/off control method which operates with fixed temperature differences. Based on the relevant simulations it is shown that compared to the ordinary control the energetically-based control provides remarkable savings in auxiliary heating energy. This result should be valid for any systems similar to the particular one in Gödöllő.

1. INTRODUCTION

In view of the possibility of harnessing solar energy in solar thermal applications and the increasing amount of such installations, it is important to develop the efficiency of solar heated systems. In order to improve any simple or combined solar heating system, physically-based modelling is an exact, theoretically overseen tool.
The aim of this work is to realize a mathematical model corresponding to solar heating systems that takes into account all the substantial energy components as well as the physically-based specifications of them. Physical bases are well described in details by Duffie and Beckman (1991). The model should be flexible for easy adapting to a wide range of solar heating systems.
A new, energetically-based control method is shown and compared with the generally used ordinary control which operates with fixed on/off temperature differences.

2. INTRODUCTION OF THE INVESTIGATED HEATING SYSTEM AND THE PHYSICALLY-BASED MODEL

2.1. Main characteristics of the solar heating system at the campus of Gödöllő

A monitored combined solar heating system which has been installed at the campus of Szent István University (SIU), Gödöllő, Hungary is sketched in Figure 1. (Let it be called SIU-system.)
The term combined means actually that the installation has more than one consumers. It preheats water for an outdoor swimming pool and, in the idle period of this operation, domestic hot water for a kindergarten nearby. Auxiliary gas heated boilers are also included which operate in the same time with the solar heating if necessary.

The main system components are the flat plate solar collector field, with a total area of 33,3 m2, oriented to the south with an inclination angle of 45°, the plate heat exchangers, a 700 m^3 outdoor swimming pool with a surface of 350 m^2 and a 2000 litres solar storage tank. According to the notations above the following parameters are monitored on the system: temperatures (T, °C), specific solar irradiance (I, W/m^2), volumetric flows ($\dot{v}$, m^3/s). Measured data are available from the year 2001, apart from minor interruptions.

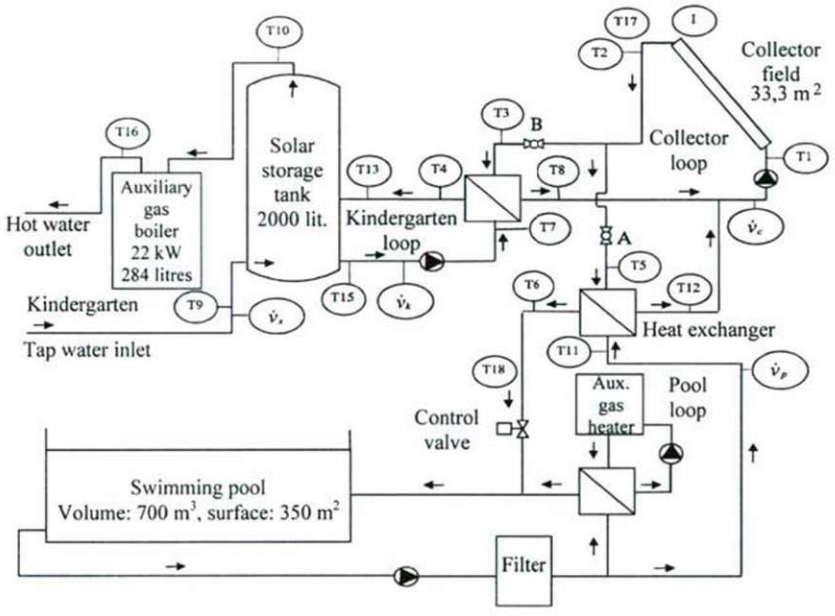


Figure 1. Simplified scheme of the combined solar heating system at the campus of SIU.

2.2. Modeling of the system

On the basis of the time-separated working, a distinct model has been elaborated for kindergarten operation (Figures 2-3), which is shown next in details.

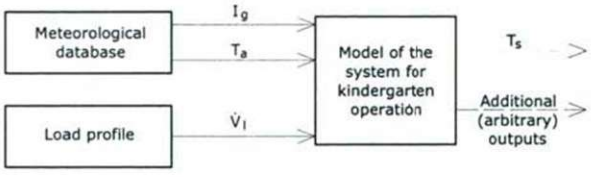


Figure 2. Flowchart of the model for kindergarten operation.

Notations: I_g: global solar irradiance on collectors' plane, W/m^2, T_a: outside, ambience temperature, °C, $\dot{V}_l$: domestic hot water load, l/h, T_s: calculated solar storage temperature, °C.

The problem was carried out by the TRNSYS 16 (Klein et al., 2005) and, for some particular calculations, by the MAPLE 8 software packages.

The main system units have been located in distinct sub-models, that are ready available in TRNSYS and can be used independently too. Such parts are the collector sub-model (Type 832 in TRNSYS (Heimrath and Haller, 2007)), the heat exchanger sub model (Type 5b), the stratified solar storage sub-model (Type 60c), the sub-model of the pumps (Type 114), the sub-model of the pipes (Type 31), the sub-model for the ordinary control (Type 2b) and the model part for the energetically-based control (Type 2b blocks with the related "Equations" blocks). It is possible to change either of them. (Actually the energetically-based control operates in Figure 3.)
(One could imagine auxiliary heating after the solar storage serially to afterheat the water till the all-time needed temperature level. It is not contained in the model now.)
The model can be run with inputs from special components. One of them is the "Meteorological database" component (Type 109) which calls a selected weather data file available in the program, the other is for the domestic hot water load ("Load profile" (Type 9c)) that also calls an external data file. (See Figure 2.)

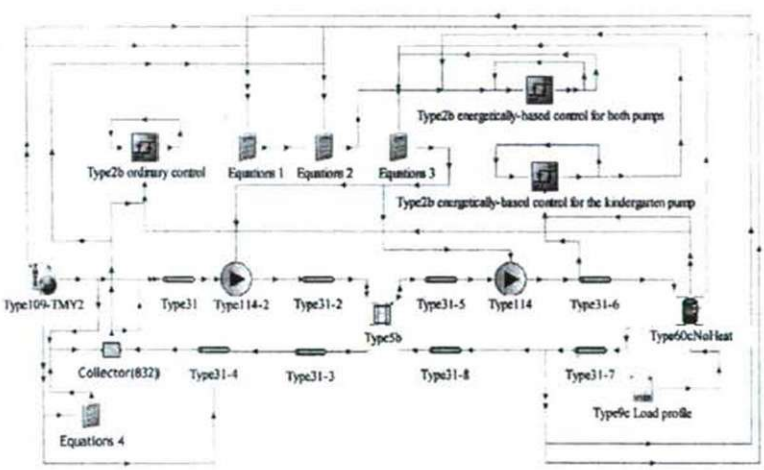


Figure 3. Flowchart scheme of the model in TRNSYS worksheet

The model determines and takes into account all energy components influencing the performance and the efficiency of the solar heating system, as like the irradiated energy on the collectors' plane, the utilized energy by the collectors, the transferred energy in the heat exchanger as well as the solar energy that finally used up by the consumers. Because of the limits in volume the specification of the other describing equations, which can be found along with their origins in the relevant TRNSYS documentation (Klein et al., 2005), is omitted now.

3. DEVELOPMENT OF THE ENERGETICALLY-BASED CONTROL

During the investigations the following one dimensional partial differential equation (Farkas and Vajk, 2002) relating to energy conservation law is needed. This equation models the cooling and delaying effects in pipelines of hydraulic systems.

$$\rho c A \frac{\partial T}{\partial t} = -\rho c \dot{V} \frac{\partial T}{\partial x} - k(T - T_{a,p}) \qquad (1)$$

Notations: A: area of pipe cross section, m^2, c: specific heat of pipe fluid, J/(kg°C), k: overall heat loss coefficient of the pipe, W/m/K, T: temperature of pipe fluid, °C, $T_{a,p}$: temperature of pipe ambience, °C, x: coordinate along the pipe, m, $\dot{V}$: volumetric flow in the pipe, m^3/s, ρ: mass density of pipe fluid, kg/m^3, t: time, s.
Here is the used energy balance equation and the equation of the Bosnjakovic-coefficient for a counter flow heat exchanger. (See Figure 4.)

$$\Phi(T_{c,h,in} - T_{k,h,in}) = T_{k,h,out} - T_{k,h,in} \qquad (2)$$

$$\Phi = \frac{1 - \exp\left(-\frac{k_h \varepsilon A_h}{\dot{W}_1}\left(1 - \frac{\dot{W}_1}{\dot{W}_2}\right)\right)}{1 - \frac{\dot{W}_1}{\dot{W}_2}\exp\left(-\frac{k_h \varepsilon A_h}{\dot{W}_1}\left(1 - \frac{\dot{W}_1}{\dot{W}_2}\right)\right)} \qquad (3)$$

Notations: Φ: Bosnjakovic-coefficient for a counter flow heat exchanger, $T_{c,h,in}$: inlet temperature to the heat exchanger from the direction of the collector field, °C, $T_{k,h,in}$: inlet temperature to the heat exchanger from the direction of the solar storage, °C, $T_{k,h,out}$: outlet temperature from the heat exchanger to the solar storage, °C, $k_h \varepsilon$: overall heat transfer coefficient of the heat exchanger between the working fluids, $W/(m^2K)$, A_h: area of heat exchanger surface between the working fluids, m^2, $\dot{W}_1$: the smaller heat capacity flow rate of the two working fluids (in our particular SIU-system it belongs to the water in the kindergarten loop), W/K, $\dot{W}_2$: the greater heat capacity flow rate of the two working fluids (of the collector fluid in the SIU-system), W/K.
So that the pumping is economical in view of energy and costs, the following criterions must be always satisfied.
At first when the pumps are on, the medium which is to be heated must feed more heat energy per time unit than the amount of electric consumption by the pumping:

$$\Delta T > \frac{P_p}{c_w \dot{V}_k \rho_w} \qquad (4)$$

Notations: ΔT: warming temperature difference of the medium which is to be heated if the pumping is on °C, P_p: actual electric consumption of the pumping in the collector- and

in the kindergarten loops, W, c_w: specific heat of water, J/(kg°C), ρ_w: mass density of water, kg/m^3.
Secondly the cost of the saved auxiliary (gas) energy per time unit by heating with solar energy the medium which is to be heated, also must be more than the cost of the consumed electric energy of the pumping:

$$\Delta T > \frac{P_p C_e}{c_w \dot{V}_k \rho_w C_g} \qquad (5)$$

Notations: C_g: specific cost of gas energy, e.g. in HUF/MJ, C_e: specific cost of electric pumping energy, e.g. in HUF/MJ.

3.1. Description of the energetically-based control

In the face of the ordinary control method which is commonly used in solar heating systems, a new energetically-based control has been elaborated for kindergarten operation though the principles are the very same in swimming pool operation too.

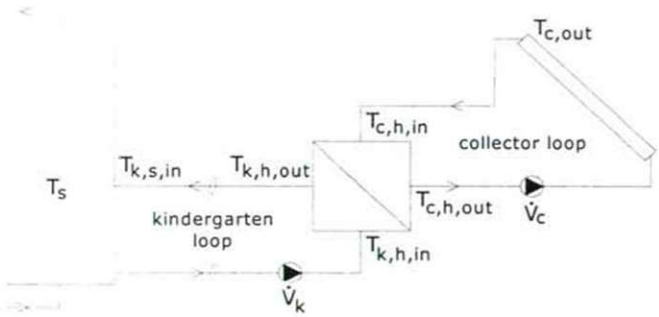


Figure 4. Simplified scheme of the solar heating system in kindergarten operation

Notations: $T_{c,out}$: outlet temperature of the collector field, °C, $T_{c,h,in}$: inlet temperature to the heat exchanger from the collector field, °C, $T_{k,s,in}$: inlet temperature to the solar storage from the direction of the heat exchanger, °C, $T_{k,s,out}$: outlet temperature from the solar storage to the heat exchanger, °C, $\dot{V}_c$: volumetric flow in the collector loop, m^3/s, $\dot{V}_k$: volumetric flow in the kindergarten loop, m^3/s.
Inside the storage there is no heat exchanger, it is not separated hydraulically from the kindergarten loop.
The pursuit of the elaborated control is the following according to Figure 4:
Case a, $T_{c,out}$, $T_{k,h,in}$, $T_{k,s,in}$ and T_s are monitored continually. Assuming switched on pumps $T_{c,h,in}$ is calculated from $T_{c,out}$ based on equation (1). Then $T_{k,h,out}$ is determined by equation (2). $T_{k,h,out}$ minus $T_{k,h,in}$ is the controlling temperature difference of the energetically-based control for both pumps. This is the one that is compared continuously with the switching off temperature difference - ΔT_{off} - that is the stricter economical criteria

according to (4) and (5) with $\Delta T = T_{k,h,out} - T_{k,h,in}$ and with the switching on temperature difference - ΔT_{on} - that is equal to ΔT_{off} plus the chosen hysteresis value - $\Delta T_{hyst} = 2$ °C.
Case b, $T_{k,s,in}$ and T_s are monitored continually. Now the controlling temperature difference is $\Delta T = T_{k,s,in} - T_s$. It is compared continuously with the switching off temperature difference - ΔT_{off} - that is the stricter economical criteria according to (4) and (5) and with the switching on temperature difference - ΔT_{on} - that is equal to $\Delta T_{off} + 0{,}2$ °C.
The collector pump works by Case a. The kindergarten pump works by the OR relation between Case a, and b,. So P_p is not the same in these cases.

3.2. Description of the ordinary control used for comparison

Generally the ordinary control switches off the pumps if T_c is less with a chosen value (e.g.: 2 °C) than T_s and switches on for another prescribed difference (e.g.: 5 °C).
The ordinary control does not deal with heat loss, only simply uses a prescribed switching off temperature difference, greater than 0 °C to ensure that the pumps work only if they take positive thermo energy into the kindergarten loop. Furthermore this value should be as small as possible to gain the most solar potential. So the efficiency of the ordinary control must be maximized to be fair to this control later, while comparing it to the new, energetically-based one.
So as to consider the biggest but still real losses in the system, let us calculate with 55 °C temperature in the kindergarten loop, 10 °C in its environment and -5 °C in the environment of the collector loop. Considering the parameters of the SIU-system and assuming switched on pumps, the minimal value of $T_{k,h,out}$ can be determined by equation (1) and the stricter condition of (4) and (5). (Here $\Delta T = T_{k,s,in} - T_s$.) $T_{k,h,in}$ can be also determined from T_s by (1). The minimal value of $T_{c,h,in}$ from (2) and $T_{c,out}$ from $T_{c,h,in}$ and (1) can be also calculated. The such resulted $T_{c,out} - T_s$ is the switching off temperature difference of the ordinary control. The hysteresis value is the same as in the energetically-based control (2 °C).

4. COMPARATIVE RESULTS OF THE ORDINARY- AND THE ENERGETICALLY-BASED CONTROL

According to the aforementioned the model has been run with the ordinary as well as with the energetically-based control then the results have been compared.
Simulation setups are according to the parameters of the SIU-system: investigated modelled day numbers: 1-5 April. Meteonorm data for Prague was used, since in TRNSYS database this place is the closest to our Hungarian system. The relevant TRNSYS weather file is: CZ-Praha-115180.tm2.
The consumption load is based on the realistic profile of Jordan and Vajen (2003) for five days without bathtub or shower with 1990 liters/day.
$\eta_0 = 0{,}74$, catalog data of the optical efficiency of the collectors, $U_L = 7$ W/m^2/K, recommendation from Bourges (1991) to the overall heat loss coefficient of the collectors, $k_h \varepsilon A_h = 5000$ W/K, determined from data given by manufacturer. $\dot{V}_c = 0$ or 1,08 m^3/h, $\dot{V}_k =$

0 or 0,65 m^3/h, P_p = 0 or 300 W for both pumps / 0 or 150 W for only kindergarten pump. Initial temperatures: collector field: 5 °C (initial ambience temperature of the day 1st April), both sides of the heat exchanger: 20 °C (assumed temperature of the maintenance house), solar storage: 20 °C (discharged solar storage), pipelines between the heat exchanger and the solar storage: 16 °C, which is the initial solar storage temperature minus 4 °C, because the pipe water has come from the solar storage before and its insulation is good: k =0,025 W/m/K by catalogue data. c_c = 3623 J/(kg°C), specific heat of collector fluid, ρ_c =1034 kg/m^3 collector fluid mass density.

Volume of the collector field: 27 litres, volume of collector side of the heat exchanger: 2,5 liters. For kindergarten side: 2,6 liters. C_g =3,3 HUF/MJ, C_e =11,1 HUF/MJ.

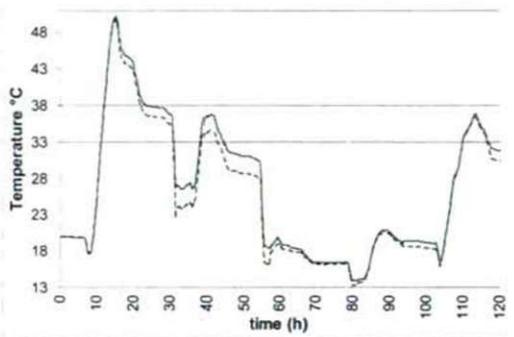


Figure 5. Average solar storage temperature by both controls

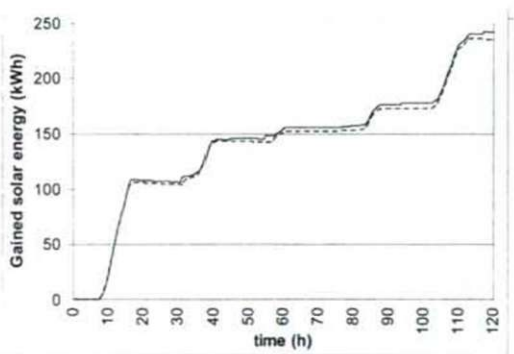


Figure 6. Gained solar energy for the kindergarten by both controls

Table 1. Results of the simulations for both controls at the end of the simulations (end of 5th April)

	Average storage temperature, °C	Gained solar energy for the kindergarten, kWh	Saved auxiliary (gas) energy, kWh
Ordinary control	30,3	235,0	-
Energetically-based control	31,8	241,8	6,8

Figure 5 and 6 show the results of the simulations comparing the two control methods. The dashed blue lines in the figures note the ordinary-, the smooth red ones note the energetically-based control. For both controls Figure 5 shows the average solar storage temperature, Figure 6 shows the sum of the consumed solar energy from the storage and the internal energy change inside the storage (compared to the initial internal energy).

5. CONCLUSIONS

Based on the simulation results it can be stated that under the same weather conditions the new, energetically-based control saved **6,8 kWh** solar energy for the consumer compared to the ordinary control which is used generally in practice. It means significant, **2,9 %** extra gained solar energy.
It should be said that the electric energy of the pumping also increases to some extent, so it is important to ponder the electric consumption surplus together with the extra gained solar energy.

6. ACKNOWLEDGEMENTS

The author says special thanks to them who contributed to a great extent to this work: To Professor István Farkas from the Department of Physics and Process Control, Szent István University, Gödöllő, Hungary for the help in making appropriate research conditions. To Professor Klaus Vajen from the Department of Solar and Systems Engineering, University of Kassel, Germany for the help in making appropriate research conditions and specially for the supply with the TRNSYS simulation environment. To János Buzás from the Department of Physics and Process Control, Szent István University for his help in many technical details. To the staff of the Department of Solar and Systems Engineering, University of Kassel for their help in many details.

REFERENCES

1. Duffie, J. A., Beckman, W. A., (1991): Solar Engineering of Thermal Processes. John Wiley and Sons, New York.
2. Klein, S. A. et al., (2005): A Transient System Simulation Program. Solar Energy Laboratory, University of Madison, USA.
3. Heimrath, R., Haller, M., (2003): Project Report A2 of Subtask A: The Reference Building, the Reference Heating System, A report of IEA SHC – Task 32. Graz University of Technology, Institute of Thermal Engineering.
4. Farkas, I., Vajk, I., (2002): Modelling and Control of a Distributed Collector Field. Energy and the Environment, I /ed. by B.Frankovic/, Croatian Solar Energy Association, Opatija, October 23-25, 2002., 91-99 p.
5. Jordan, U., Vajen, K., (2003): DHWcalc, version 1.10 - Tool for the Generation of Domestic Hot Water (DHW) Profiles on a Statistical Basis. University of Kassel, Institute of Thermal Engineering, Solar and Systems Engineering.
6. Bourges, B., (1991): European Simplified Methods for Active Solar System Design. Kluwer Academic Publishers for CEC.

This work has been supported by the Hungarian State Eötvös Scholarship.

Ez a munka a Magyar Állami Eötvös Ösztöndíj támogatásával készült.

NON-THERMAL EFFECT OF MICROWAVE TREATMENT ON ENZYME SUSPENSIONS PART I.: WATER ELECTROLYSIS

Ágnes Szerencsi, Erika Lakatos, Attila József Kovács, Miklós Nemenyi
University of West Hungary, Institute of Biosystems Engineering
Vár 2., Mosonmagyaróvár, 9200, Hungary
e-mail: szerencsia@mtk.nyme.hu; lakatose@mtk.nyme.hu; kovacsaj@mtk.nyme.hu; nemenyim@mtk.nyme.hu

ABSTRACT

In previous researches it was showed that cellulase enzyme activity could be raised by microwave treatment. Also the physiological cell division process of microorganisms could be influenced by the microwave effect that is a higher number of cells could be reached by examining the *Saccharomyces cerevisiae*. As these structures are in aqueous media, the aim of the research was to find the effect of microwave on water that is present in all biological medium. After low-intensity microwave treatment of 1% NaCl water solution electrolysis was carried out in Hofmann's Voltameter. To focus only on the non-thermal effect, as control, an other fluid was warmed up on hotplate by the same heating parameters. We came to the result that the speed of water decomposition of microwave-treated water is higher, than those of the control. The results showed clearly, that microwave has an effect on the water and so indirectly on every substance that is present in water. In the case of samples irradiated by microwave electrolysis was faster even 48 hours after treatments compared to the control samples. Water was able to remember the electromagnetic waves of low intensity microwave treatment, so this result proved the memory effect of water.

1. INTRODUCTION

Recently, a lot of research projects focus on the non-thermal effects of microwave. Non-thermal heat-shock can be induced by low-intensity microwave fields (Pomerai et al., 2000). In substances such as water, molecules have permanent electric dipole because of the different electro-negatives of individual atoms. Some biological materials may be affected by very slow energies, such as in the case of hydrogen-bonded structures, in which protons may be displaced at very low energy expense. The molecules gain some energy by the dipolar polarization behavior (Schubert et al., 2005). The dielectric constant of water is very high; therefore water can store the electric field energy (Géczi, 2002). By certain frequence-, power-, and time values there are strong interactions among cells and macromolecules, but beyond these values interactions are negligible (Mátay et al., 2000). Water is an essential aqueous media of physiological processes. It takes part of cell-cell communication and transmits information via electromagnetic waves. These properties are utilized in alternative medicine and in applied researches as well. In previous researches it was found that cellulase enzyme activity could be raised 20% by microwave treatment (Nemenyi et al. 2008a). Also the physiological cell division process of microorganisms such as in the *Saccharomyces cerevisiae* can be accelerated by examining microwave effect (Grundler et al., 1977; Nemenyi et al., 2008b).
During our examinations a question aroused in connection with the microwave: does the microwave have a direct or indirect influence? Does it effect the enzyme, the water, or both? The aim of the examination was to detect the effect of microwave irradiation on

water, which is present in the suspension of the enzyme and in all aqueous media around cells. It was found, that microwave has an influence on the electrolytic decomposition of KOH water solution (Dragomir et al, 2007). In order to detect water decomposition affected by microwave, electrolysis was used to the experiments.

2. MATERIALS AND METHODS

NaCl water solution (1%, 200 ml, 12 °C) was treated by microwave at 100 W, for 50 minutes till the temperature reached 45 °C. To focus on the non-thermal effect of microwave, as control an other solution was heated by the same heating parameters on hotplate. As reference control untreated 1% NaCl water solution was used. A PANASONIC NNF 653 WF domestic microwave oven with a FISO MWS-4 fiber optic thermometer was used for microwave treatments. The power was continuously emitted by the special designed inverter type oven (Lakatos, 2006) in contrast to most of the commercial ovens where the microwave power is pulsated. The treatment parameters were adjusted by a computer connected to the oven. Hence, individual programming could be carried out. Temperature changes of the treated samples were followed by the in-built fiber optic thermometer. This measures temperature based on Fabry-Perot interferometry (Datta and Anantheswaran, 2001). The teflon sample holder (diameter: 85 mm, height: 60 mm, about 340 ml) is placed in the middle of the turntable (Figure 1.). Four other containers (diameter: 38 mm, height: 100 mm of each, about 113 ml) filled with 90 g 12 °C tapwater working as water trap were evenly distributed in radial direction from the center for given distances. The aim of that is to change the inhomogeneous electromagnetic field inside the microwave oven to homogenious field.

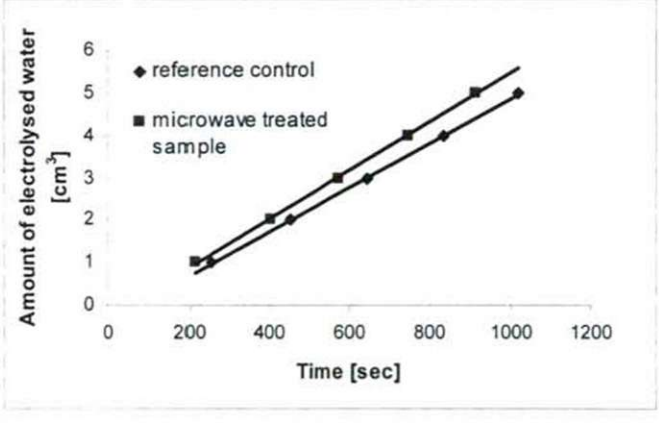
Fiure 1. PANASONIC NNF 653 WF type domestic microwave oven with a FISO MWS-4 fiber optic thermometer on the top of it. Inside: four watertrap containers and the sample holder in the middle of turntable

After treatment water electrolysis was carried out in Hofmann Voltameter apparatus. In the first series of experiments 24 V was used, then 12 V in the second ones. When current is running through Hofmann's Voltameter, gaseous oxygen forms at the anode and gaseous hydrogen at the cathode. Each gas displaces water and collects at the top of the two outer tubes. The speed of electrolysis of microwave treated sample and those of control can be measured by stopper observing the decreasing level of water in the calibrated tubes. The

presence of gas in the collecting tube can be detected with a smoldering match or "glowing wood splint". Oxygen will cause the match to immediately burst into a bright white flame and will burn vigorously, while the presence of hydrogen gas will create a "pop" sound due to the hydrogen rapidly burning. In our research we examined the speed of water electrolysis shortly, 24 and 48 hours after treatment. We measured changes in pH aswell. In another case only distilled water was treated by microwave and just before electrolysis was given NaCl (1%) to the sample.

3. RESULTS AND DISCUSSION

The first series of experiments showed (Figure 2.) that there was an obvious difference (13%) in speed of electrolysis by 24 V between microwave treated NaCl water solution and the reference control. From all cases water electrolysis was the most fast, when sample was treated by microwave and 24 V was used in Hofman's Voltameter.



Fiure 2. Electrolysis of microwave-treated water and that of untreated reference sample – by 24 V

The second series of experiments (Fig. 3) resulted that electrolysis (12 V) of microwave treated water sample was 10% faster than those of samples heated on hotplate by the same heating parameters. We could determine, that even after 24 and 48 hours of treatment (Fig. 4) the process of water electrolysis was (6% and 4%) faster by microwave irradiated samples than those of the controls. Due to the one-factor analysis of variance the significance level is 95% examining the difference between microwave treatment and hotplate. Comparing the two methods of treatments there were no difference in the measured pH values of the samples. The pH changed neither before nor after microwave treatment. However acidity varied (from: pH =7.10 to: pH=10.28) during water electrolysis. In case when NaCl was given only to the treated distillated water, we could determine minimal difference (3%) in speed of electrolysis between the two methods of treatments.

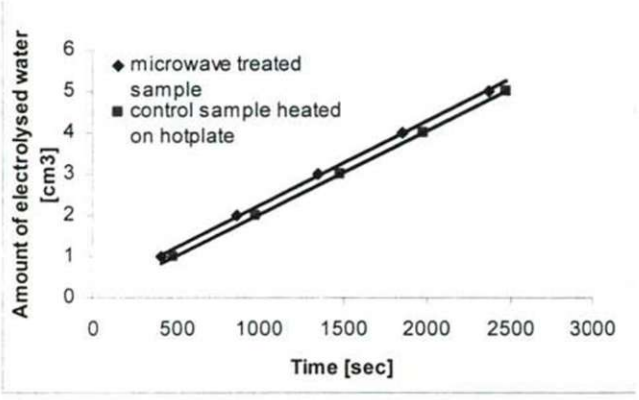


Figure 3. Comparing the electrolysis of water, treated by microwave, and the control sample, heated on hotplate – by 12 V, shortly after the treatment

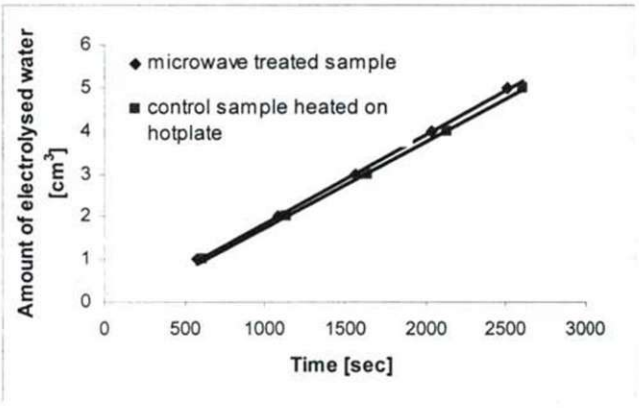


Figure 4. Comparing the electrolysis of water, treated by microwave, and the control sample, heated on hotplate – by 12 V, 48 hours after the treatment

The results of all experiments show clearly, that microwave treated water can be electrolysed faster, than water heated on hotplate or water hasn't been treated at all. Consequently less energy is needed to water electrolysis in case when microwave was used. In the research the non-thermal effect of microwave has been showed. It has an effect among different materials on the water aswell. In the course of our experiments it was proved, that water was surely treated by microwave. As water is a basic and unexceedable medium of most materials, it may affect all microwave treated materials in an indirect way. It happens when cellulase enzyme activity was enhanced by microwave treatment, also its medium: the water was treated. This means that it can influence the enzyme indirectly. The experiments show obviously, that water was able to remember the electromagnetic waves of low intensity microwave treatment even 48 hours long. Our results proved the memory effect of water.

4. CONCLUSIONS

Thank the results more information about the behaviour of water is available, which is important to carry out further research in connection with microwave treatment. The purpose of future experiments is the examination of microwave treated suspensions of enzymes and microorganisms. This contributes to the expansion of production efficiancy by second generation of bioethanol promoted also by the EU7 framework.

REFERENCES

1. Datta, A.K., Anantheswaran, R.C. (2001): Handbook of Microwave Technology for Food Applications. Marcel Dekker, Inc., New York.
2. Dragomir R. Stanisavljev, Tomislav D. Grozdić, Milica P. Marčeta Kaninski, Antonije R. Djordjević and Dragica Lj. Stojić (2007): The microwave influence on the electrolytic decomposition of KOH water solution Electrochemistry Communications Vol. 9(5), pp. 901-904.
3. Géczi G. (2002): Összefüggések mezőgazdasági termények dielektromos jellemzőinek meghatározására, (Relationships of determination of dielectric properties of agricultural products), Mezőgazdasági Technika, April, pp. 2-4.
4. Grundler W., Keilman F., Fröhlich H. (1977): Resonant growth rate response of yeast cells irradiated by weak microwaves. Physics letters 62A: 463-466 pp.
5. Lakatos E. (2006): Treatments of liquid foodstuffs with special regard to the effect of microwave on milk. PhD thesis. Mosonmagyarovar, 85-88.
6. Mátay G., Zombory L. (2000): A rádiófrekvenciás sugárzás élettani hatásai és orvosbiológiai alkalmazásai, Műegyetemi Kiadó ISBN 963 420 658 1.
7. Némenyi M., Lakatos E., Kovacs A., Szerencsi Á. (2008a): The effect of microwave treatment on cellulase enzyme activity. EurAgEng-International Conference on Agricultural Engineering, Hersonissos, Crete, Greece, 2008 06 23-25. Book of Abstracts-Agricultural&Biosystems Engineering for a Sustainable World, p. 06, Conference Proceedings CD.
8. Némenyi M., Lakatos E., Kovács A.J., Szerencsi A. (2008b): Mikrohullámú kezelés hatása az élesztősejtekre (*Saccharomyces cerevisiae*). XXXII. Óvári Tudományos Nap, Agrárműszaki Kutatási és fejlesztési szekció, 2008. 10. 9., Mosonmagyaróvár, Hungary, Előadások és poszterek összefoglaló anyaga, NYME University of West Hungary, Konferencia CD.
9. Pomerai D., Daniells C., David H., Allan J., Duce I., Mutwakil M., Thomas D., Sewel P.,Tattersal J., Jones D., Candido P (2000): Non-thermal heat shock response to microwaves. Nature. 405. pp 417-418.
10. Schubert H., Regier M. (2005): The microwave processing of foods, Woodhead Publishing Limited and CRC Press LCC, Cambridge, England.

NON-THERMAL EFFECT OF MICROWAVE TREATMENT ON ENZYME SUSPENSIONS
PART II.: CELLULASE ENZYME ACTIVITY

Erika Lakatos, Attila J. Kovács, Ágnes Szerencsi, Miklós Neményi
University of West Hungary, Institute of Biosystems Engineering
Vár 2., Mosonmagyaróvár, 9200, Hungary
e-mail: lakatose@mtk.nyme.hu; kovacsaj@mtk.nyme.hu; szerencsia@mtk.nyme.hu;
nemenyim@mtk.nyme.hu

ABSTRACT

Renewable fuel production (the second generation bio-ethanol production) is one of the key areas of the EU 7th Framework Programme. One of the challenges in this research area is that the degradation of cellulose materials into glucose is very expensive at the moment. Our research aim was to enhance the activity of cellobiohydrolase enzyme using only physical methods. At the beginning of this research we used D-(+)-cellobiose as substrate. During treatments a special designed inverter type microwave oven was used running on 50 W. In this equipment the temperature of enzyme-substrate solution was increased until 45 °C. As control measurement the suspension was heated up on a hot-plate until 45 °C. After the treatment samples were incubated at 37 °C. Enzyme activity was measured at 505 nm by determining glucose concentration. Based on the results the produced glucose of the microwave treated solution was 20% higher than in the solution heated up on a hot-plate.

1. INTRODUCTION

Renewable fuel production is one of the key areas of the EU 7th Framework Programme. Bioethanol has an increasing importance among bio-fuels. According to the International Energy Agency, cellulosic ethanol could allow ethanol fuels to play a much bigger role in the future than previously thought. Cellulose fibers, the major component in plant cells walls, can be converted to generate ethanol. This process is however still expensive and complicated. (Gray, 2006; László et al., 2007).

Forest and agricultural residues (e.g. corn fiber, wheat straw) or energy crops like energy grass could be used as reasonable raw materials for cellulose based ethanol production (Ohgren, 2007; Gáspár et al., 2008,). Cellulose is the raw material of the future, at the same time the degradation into glucose is very expensive now. This degradation can be carried out either with chemical methods like acid working on high temperature, and perhaps on high pressure or with help of the cellulase enzyme system (Balat et al., 2008; Hu and Wen, 2008). The high cost arises in the first case from the extreme technological conditions and chemicals, while in the second case the price of cellulase (Réczey, 1996).

Environmental pollution caused by chemicals is not negligible; therefore we have focused our experiments on enzymatic cellulose degradation. Our research aim was to enhance the activity of cellulase enzyme by using only physical methods.

Recently, more and more research projects (Kermasha et al., 1993; Tajchakavit and Ramaswamy, 1997) are dealing with the non-thermal effects of microwave. Several different researches attempt to clarify this non-thermal effect, e.g. non-thermal heat-shock

induced by low-intensity microwave fields (Pomerai et al., 2000; Ma et al., 2009). The effects of microwave irradiation on enzyme-catalyzed reactions were also published (Roy and Gupta, 2003).

2. MATERIALS AND METHODS

At the beginning of this research a specially designed PANASONIC NNF 653 WF inverter type domestic microwave oven with a FISO MWS-4 fiber optic thermometer was used for microwave treatments running on 50 W at 2.45 GHz (Lakatos, 2006). The power was continuously emitted by the inverter type oven (in contrast to most of the commercial ovens where the microwave power is pulsated). The treatment parameters were adjusted by a computer connected to the oven. Hence individual programming could be carried out. The inside temperature changes the treated materials were followed by the in-built fiber optic thermometer that measures temperature inside microwave field based on Fabry-Perot interferometry (Datta and Anantheswaran, 2001). The homogeneous microwave field i.e. even temperature distribution (Figure 1) was ensured based on our previous examinations (Lakatos et al., 2005). In our experiment D-(+)-cellobiose (Sigma-Aldrich) was used as substrate and 1,4-(1,3:1,4)-B-D-Glucan-4glucano-hydrolase (Sigma-Aldrich, ATCC 26921) in a pH 4.6 buffer solution as the enzyme.

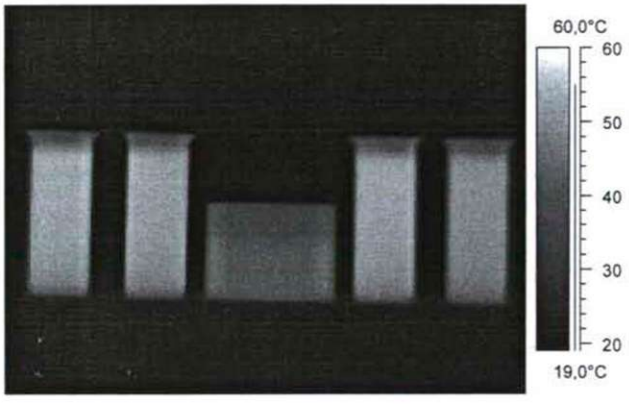


Figure 1. Infrared image of the sample holder can (middle) and the four water trap containers. (Source: Neményi et al., 2006.)

The increase of glucose content referring for enzyme activity changes were measured directly and every 30 minutes after the treatments by using Hitachi UV/Vis spectrophotometer. The duration of increased enzyme activity level was also studied. The treated suspensions were stored in refrigerator at 8 °C for 48 and 96 hours. After this time period the suspensions were heated up on a hotplate up to 37 °C then, the glucose content was measured by spectrophotometer in 30 minute intervals.

During our examinations a question aroused whether the effect of microwave radiation influences the enzymes, the buffer solution or both (Szerencsi et al., 2009). Henceforth, only the buffer solution was heated by microwave and on hotplate. After this heating the enzyme and substrate were added to the pretreated buffer solution, then the glucose content

of samples was detected. In this case the non-thermal microwave radiation could only affect the buffer solution.

The aim of the examination was to reveal the non-thermal effect of microwave irradiation on change of cellulose enzyme in the suspension.

3. RESULTS AND DISCUSSION

In our equipment the temperature of enzyme-substrate solution was increased only until 45 °C for 45 min. (The microwave treatment in this temperature is still considered to be non-thermal.) The control suspension was heated up on a hot-plate until 45 °C for 45 min. After this treatment the samples were incubated on 37 °C.

Directly after the treatment and during incubation in 30 min intervals the enzyme activity was measured at 505 nm (Figure 2).

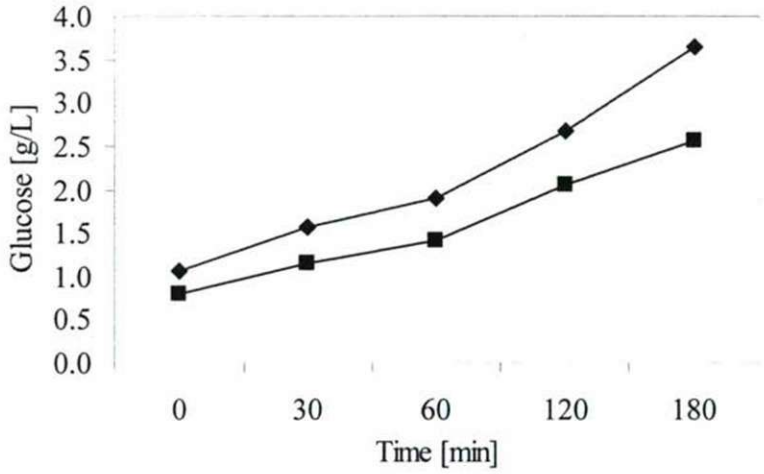


Figure 2. The increased cellulase enzyme activity after microwave (◆) and conventional heat treatment (■) in enzyme substrate suspension.

As the result shows the enzyme activity of microwave treated solution was 20% higher than in the solution heated up on a hot-plate. Significant differences were found between the microwave treated and the heat plate heated (control) samples.

In the long duration experiment we compared enzyme activity changes in stored and in freshly prepared samples (Figure 3).

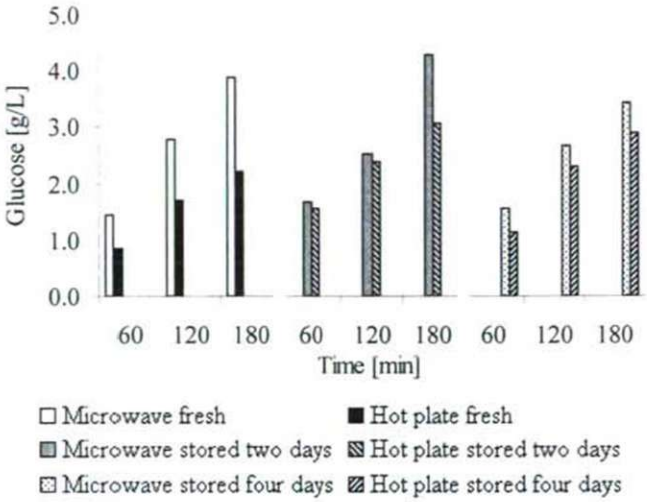


Figure 3. The changed cellulase enzyme activity of microwave and conventional heat treatments; directly after treatment, 48 hours and 96 hours later.

The microwave treated enzyme suspension still has increased activity after 96 hours of treatments.

Figure 4 shows the results of experiments, where only the buffer suspension was treated and the enzyme and substrate were added hereafter. Directly after treatment and during incubation in every 30 minutes the glucose content was measured. In this case the differences were smaller between microwave and conventional heating methods.

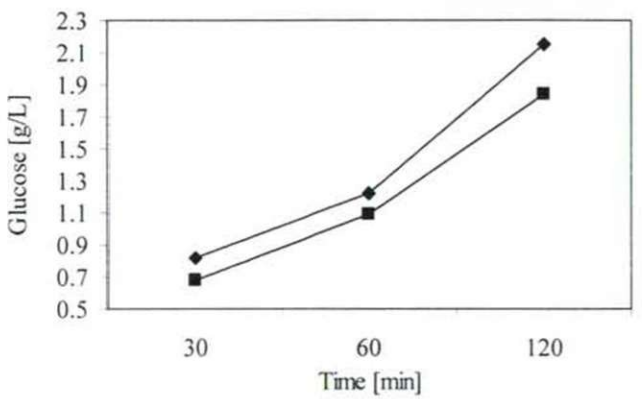


Figure 4. The increased cellulase enzyme activity after microwave (◆) and conventional heat treatment (■) in buffer suspension.

4. CONCLUSIONS

Cellulase enzyme systems have fundamental importance in second generation bioethanol production. Based on our results it can be concluded that the electron magnetic radiation of microwave treatment of enzyme suspension increases the cellulase enzyme activity. This activity still remains after 96 hours and also can be detected if only the buffer solution is treated. The enzyme activity can be significantly enhanced by microwave treatment, so it could be exploited in case of bioethanol production.

REFERENCES

1. Balata, M., Balata, H., ÖZ, C. (2008): Progress in bioethanol processing. Progress in Energy and Combustion Science. 2008:34 551–573 p.
2. Datta, A.K., Anantheswaran, R.C. (2001): Handbook of Microwave Technology for Food Applications. Marcel Dekker, Inc., New York.
3. Gáspár, M., Kálmán, G., Réczey, K. (2008): Corn fiber as a raw material for hemicellulose and ethanol production. Process Biochemistry. 2008:42 1135–1139 p.
4. Gray, A.K., Zhao, L., Emptage, M., (2006): Bioethanol. Current Opinion in Chemical Biology. 2006:10, 141–146 p.
5. Hu, Z, Wen, Z (2008): Enhancing enzymatic digestibility of switchgrass by microwave-assisted alkali pretreatment. Biochemical Engineering Journal, 2008:38 369–378 p.
6. Kermasha. S., Bisakowski. B., Ramaswamy. H., Van de Voort. F.R. (1993): Thermal and microwave inactivation of soybean lipoxygenase. Lebensmittel Wissenschaft und Technologie. 1993:26, 215-219 p.
7. Lakatos E. (2006): Treatments of liquid foodstuffs with special regard to the effect of microwave on milk. PhD thesis. Mosonmagyaróvar.
8. Lakatos, E., Kovács, A.J., Neményi, M. (2005): Homogenious microwave field creation. Hungarian Agricultural Engineering. 2005:18. 80-81. p.
9. László, Zs., Beszédes, S., Kertész, Sz., Hodúr, C., Szabó, G., Kiricsi, I. (2007): Bioethanol from sweet sorghum. Hungarian Agricultural Engineering 2007:20. 15-17. p.
10. Ma, H., Liu, W., Chen, X., Wua, J., Yu, Z. (2009): Enhanced enzymatic saccharification of rice straw by microwave pretreatment. Bioresource Technology, 2009:100 1279–1284 p.
11. Neményi, M., Lakatos, E., Kovács, A.J. (2006): Examination of milk fat globule changes in homogeneous microwave field. Journal of Food Physics. 2006:17-18. 29-42. p.
12. Ohgren, K., Vehmaanper, J., Siika-Aho, M., Galbe ,M., Viikari, L., Zacchi, G. (2007): High temperature enzymatic prehydrolysis prior to simultaneous saccharification and fermentation of steam pretreated corn stover for ethanol production. Enzyme and Microbial Technology 2007: 40, 607–613. p.
13. Pomerai, D., Daniells, C., David, H., Allan, J., Duce, I., Mutwakil, M., Thomas, D., Sewel, P.,Tattersal J., Jones D., Candido P. Non-thermal heat shock response to microwaves. Nature 2000, 405, 417-418 p.

14. Pomerai, D., Daniells, C., David, H., Allan, J., Duce, I., Mutwakil, M., Thomas, D., Sewel, P., Tattersal, J., Jones, D., Candido, P. (2000): Non-thermal heat shock response to microwaves. Nature. 2005:405. 417-418 p.
15. Reczey, K., Szengyel, Zs., Eklund, R., Zacchi, G. (1996): Cellulase production by T. reesei. Bioresource Technology. 1996:57 25-30. p.
16. Roy, I., Gupta, M.N. (2003): Non-thermal effects of microwaves on protease-catalyzed sterification and transesterification. Tetrahedron. 2003:59, 5431-5436. p.
17. Szerencsi, A., Lakatos, E., Kovács, A.J., Neményi, M. (2009): Non-thermal effect of microwave treatment on enzyme syspension. Part I. water electrolysis. Review of Faculty of engineering. Analecta Technica Szegedinensia. In press.
18. Tajchakavit, S., Ramaswamy, H.S. (1997): Thermal vs. microwave inactivation kinetics of pectin methylesterase in orange juice under batch mode heating conditions. Lebensmittel Wissenschaft und Technologie

PRIMER KVANTITAVIVE SURVEY IN CASE OF THE MEAT QUALITY AND SAFETY

E. Vincze-Lendvai
University of Szeged, Faculty of Engineering

ABSTRACT

Mangers of a meat-processing small works were interested in the customers' behaviour. I made the personal questionnaire method to recognize attitudes, motivations and opinions. In my survey I asked the buyers about the place of shopping, the main reasons of their choice, and the most important differences in the food safety between the small and the big factories.
The main conclusions of the examination are: most answerers do their shopping in the hypermarkets, because of the rich selection and the low price, but a little part of the buyers likes small meat-shops or the meat-market, because of the quality and the freshness. When they choose a meat-product a lot of answerers are wedded to one maker. The people usually buy meat-products of big companies. In the most purchasers' view the big meat-companies are reliable, and they like their products, but the little part of them believe only in the small companies, they believe in their products, they think their meat-quality and food safety are better.

Key words: consumers' survey, meat-quality, food safety

1. INTRODUCTION

I carried out a survey on purchasing behaviour upon the request of a meat-processing firm in the Region of the Southern Plain, the proper scope of which is meat-processing, retail and wholesale trade of meat and meat products, in addition to pig-breeding. Managers of the firm wanted to obtain some information about:

- purchasing habits in connection with meat products
- consumer preferences
- motivations to purchase something
- opinions about small and big meat-processing firms

2. MATERIAL AND METHODS

To achieve my research aim I chose the questionnaire method. Using this method I got answers quickly, on the one hand, while I obtained enough numerical data, on the other hand, which helped me to perform correct evaluation. At the same time I gave the answerers the opportunity to write down their opinion which later could tinge and support the numerical assessment.

I chose the answerers randomly without aiming for being representative, since the main purpose was to sketch a general outline of the problem in question.

The questionnaire was filled in with the help of the Internet, which partly tightened the circle of the potential answerers (Internet-users) but it made possible that the questionnaire could reach every part of the country within minutes.

3. RESULTS AND DISCUSSION

Although I did not aim for being representative I still made the effort to ask people from both sex, from different age, with different level of education and from different residence. Structure of answerers is shown in Table 1.

Table 1.Demographical structure of answerers (%)

Sex	*man*	*woman*					
	20,0	80,0					
Age group	*18-30*	*31-45*	*45-60*	*60-*			
	20,0	57,0	20,0	3,0			
Place of residence	*Southern Plain*	*Northern Plain*	*Northern Hungary*	*Mid-Transdanubia*	*Southern Transdanubia*	*Western Transdanubia*	*Mid-Hungary*
	47,0	3,0	10,0	5,0	13,0	3,0	19,0
Educational level	*elementary*	*secondary*	*higher*				
	2,0	25,0	73,0				
Activity	*employee*	*student*	*pensioner*	*other*			
	65,0	10,0	5,0	20,0			
Income	*Much worse than the average*	*Worse than the average*	*Average*	*Better than the average*	*Better than the average*		
	0,0	7,0	62,0	28,0	3,0		

The first question referred to the place of food purchase. From different kind of shops the supermarket was preferred (45,0%), while other places got the less point (3,0%). Only a small part of the answerers mentioned discount shops (7,0%) and small shops (8,0%), on the other hand, chains of stores – for example, Coop, CBA-, and bigger networks of shops – for example Spar- were chosen in a higher rate (16,0% and 21,0%).

We can study the places of meat purchase from the following answers. Purchase can be performed together with other foods (57,0%), or in places different from them (43,0%). The first example was marked by those who go shopping to supermarkets or bigger department stores, referring to the wider selection of goods and sales. Those who buy meat somewhere else mentioned the market place and the butcher's shop, however, there are some people who get the necessary meat from relatives, friends. (Lehota 2001, Kotler 2006)

To support the choice of the shop the answerers gave different explanations (Figure 1).

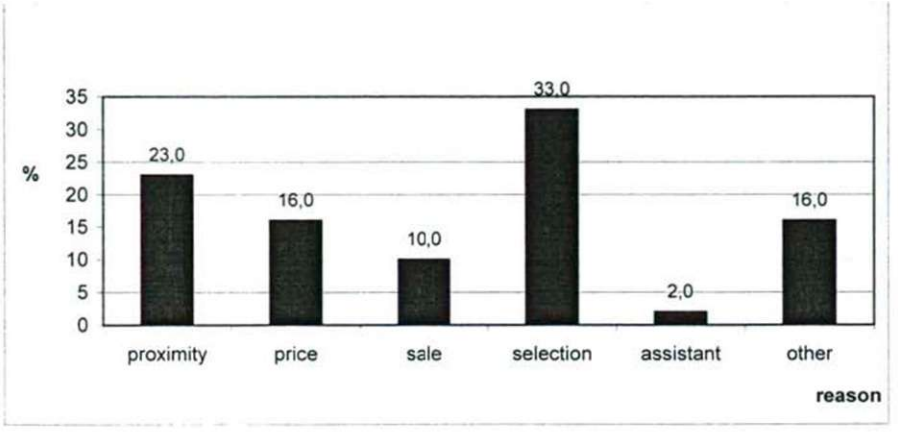


Figure 1. Structure of answerers according to the motivation of the place of purchase

Most of them (33,0%) explained their decision with the wider choice of goods which also means that they buy everything in one place in order to save time. It is verified by the importance of "proximity" which is marked as the second most important reason (23,0%) meaning saving of time again. Price is an important factor too, since "the generally low prices" and "current sales" motivate 26,0% of the answerers altogether to buy something.

Those customers who get the meat from "other" places gave the following reasons (literal quotations):

- It has a better quality; who invest work, energy, knowledge, hope and time can share more profite this way,
- Reliability,
- Good quality, fresh products,
- The meat is always fresh, they know me because I regularly do my shopping there,
- Fresh Hungarian products,
- Foods are safe,

which means that the most important factors are quality, freshness and reliability. (Gal 2008, Gal-Kiss 2008)

We can decide to choose a certain meat product from several points of view. The opinion of the repliers is shown in Table 2.

Table 2. The most important factors in purchasing a certain meat product

Reasons	Structure of answerers (%)
Same products	42,0
Maker	45,0
Price	6,0
Commercial	2,0
Package	0,0
other	5,0

We can conclude from the figure that most of the answerers (45,0%) choose the products of the same manufacturer because they know and like them. A similar number of the repliers (42,0%) say that they generally buy the same product, independently from its maker. The other factors were important only for some answerers. The following motivations belong to the "other" reasons:

- Appearance,
- Necessity
- Content, ingredients

To continue my research I would like to describe the differences in the opinions on small- and big firms. Firstly, I asked the participants about their preferences regarding the type of firms, and, if they can, to mark the manufacturer. It can be concluded, according to the answers, that a much bigger part of the costumers (56,0%) buy the products of bigger factories than the ones from smaller meat-processing firms (20,0%). Besides, a significant number of the answerers (24,0%) said that they did not know or were not interested in the name of the manufacturer. However, they listed mostly "Pick" and "Délhús" and some poultry processing plants. Only a few of them could list smaller meat processing firms. (Törőcsik 2006, 2007)

Question on reliability belongs to this problem and the following results can be experienced: nearly the half of the answerers (48,0%) put trust in bigger firms, and less than their quarter (23,0%) have faith in smaller plants. On the other hand, the name of the firm does not matter for 29,0% of the costumers – they believe in neither of them.

Those who prefer bigger companies explained their decision as it follows (literal quotations):

- Bigger firms are controlled better,
- They generally distribute examined and checked products, since the scandals they have paid more attention to the expire date,
- Checked hygienic conditions,
- They cannot allow themselves to have more serious scandals,
- Stricter quality control,
- More products are sold so there is not a bigger quantity of older ones to sell,
- Developed technology,
- Smaller firms can cheat more easily,
- They are bound by rules more strictly.

Those who chose smaller firms verified their decision this way:

- They can pay more attention to the process, their products are closer to the "home-made" ones,
- They know the firm, like its products and trust them,
- Quality is important for smaller ones as well, since they can easily lose their costumers,

- They do not sell "uniformed" products,
- Perhaps they pay more attention to quality,
- They have a better overlook because of the quantity,
- They may not dare to distribute bad products in a small town,
- It is important to be fresh in case of products so it may be easier to follow a smaller stock.

Finally, I listed some statements and it was the answerers' task to decide whether they judge them as true or false (Figure 2.). The following statement was thought to be true by almost everyone (91,0%): "The system of quality control is obligatory for each firm." (This opposes the above mentioned explanations!) However, 60% think that "bigger firms are controlled better than smaller ones, and regulations are kept more strictly, too" (it can be paralleled with what I mentioned in connection with reliability). The statement: "bigger firms try to get more profit rather than to reach higher quality" is thought to be real by 45,0% of the repliers which is not a too positive opinion about bigger firms, anyway. Also, 38.0% consider the products of big companies better than the ones in case of small firms ("Products of big meat-processing enterprises are of better quality than the ones of small businesses"). A bit more (56,0%) criticize the small plants by disagreeing with the following statement: "Small enterprises cannot allow to make products of not suitable quality". Regarding the issue from the aspect of big firms: according to the participants of the research, although the system of quality control is obligatory for every firm. They are controlled more times than smaller ones, it is still not sure that their products are better. Moreover, it is generally thought they are aiming at making profit only.

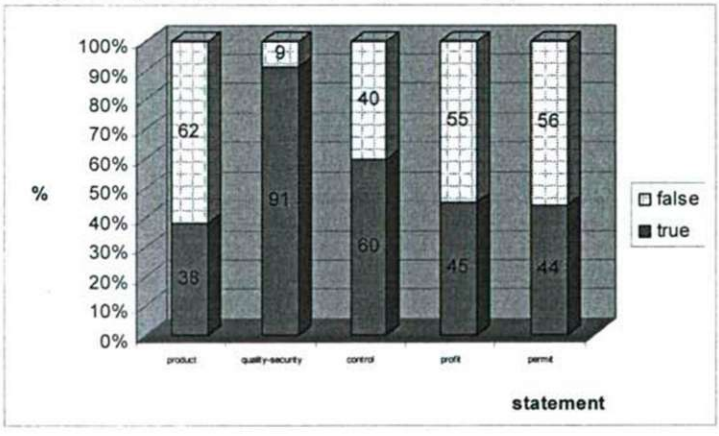


Figure 2. Structure of answerers considering some statements true or false (%)

4. CONCLUSIONS, SUGGESTION

Regarding the answers of the questionnaire I made the following conclusion:

- In case of purchase it is important to save time and money that is why the answerers prefer supermarkets with wider selection of goods and with current sales.

- The firm should count on the –unfortunately, small- group which regards quality, reliability more important; who know the shop assistant and dislike the impersonal mammut-stores. It would be the subject of a further research to find out who they are exactly and what parametres they have.
- Trust in bigger firms is based on false belief, this misbelief should be dispelled. Reconstruction of the image in case of small firms should be carried out with the help of a well-based PR activity. It should not be done independently but in cooperation with other smaller companies, or with an outside help, for example with a support from "Hús-Céh".
- Sale of products could be increased with a wider range of marketing tools: methods to stimulate sale (sales, samples), exhibitions, fairs, brochures, direct marketing.

BIBLIOGRAPHY

1. Gal, J. (2008): Food Safety and Quality in Logistics Process in People's View, (Az élelmiszerbiztonság és minőség a logisztikai folyamatban az emberek megítélése alapján) (angol nyelven), The 3rd International Scientific Conference, Safety and Quality of Raw Materials and Foodstuffs, 31st January – 1 st February 2008, Nitra, Slovakia, pp. 157-160.
2. Gál J. – Kiss A. G. (2008): Vadhús a logisztikai folyamatban, IM, Hódmezővásárhely.
3. Kotler, P. (2006) Marketingmenedzsment. Budapest, Akadémiai Kiadó.
4. Lehota J. (2001.): Élelmiszergazdasági marketing. Műszaki Könyvkiadó, Budapest.
5. Törőcsik M. (2007.): Vásárlói Magatartás. Akadémiai Kiadó, Budapest.
6. Törőcsik M. (2006.): Fogyasztói magatartás-trendek. Akadémiai Kiadó, Budapest .

THE IMPORTANCE OF NICHE MARKETING STRATEGY ON THE MARKET OF "SPECIAL FOODS"

Ágota Panyor
University of Szeged, Faculty of Engineering

ABSTRACT

The agri-food market of the developed countries has become saturated, healthy nutrition is emphasized, and the food safety is valued.
The oversupply of mass products has made a great competition, where the small and medium- size firms should find outbreak points to stay alive. One possibility is to produce special, unique products with high added value and high quality. Special food products – their uniqueness may derive from tradition, geographical characteristics or organic production – satisfy special demands. Because of producing them in low quantity, they are suitable for filling market gaps (niche).
The application of the niche marketing could help companies to stay in the quantity products' market with their special products. With the niche orientation they could stabilize their customers and make themselves differ from their competitors.
To make the niche marketing effective, collective marketing activity is necessary. Although companies recognize the importance of adaptation to the different market situations, they can't take the suitable steps alone. Therefore collective marketing has distinguished importance, for in its frame market research, product policy, advertising and distribution channels can be operated more efficiently, while companies can keep their corporate identity.

1. INTRODUCTION

The mass production and oversupply characteristic to the developed markets result in heavy competition, in which the situation of small and medium-size firms deteriorates more and more in the struggle for gaining consumers.
A chance for these lesser enterprises is to provide such a product or service to the customers, which is highly appreciated by the consumer. Their task is to produce and offer such products, which not only have apparent, but real values. These can be special foods, which are highly processed, and even their added value proportion is higher.
Even future trends justify that the demand for special foods of unique quality grows more and more. While in case of mass products, the decisive factor is the price, the key factors for purchasing special foods are their unique features and their quality.

2. SPECIAL FOODS

Among today's competing market situations the unique features of products – which have been created and subsisted during generations – show the appreciated and constant quality, they represent value.
The concept of „special foods" can be defined in wider sense as such kind of foods which are yet not widely spread in public consumption. They represent unique quality, which in my opinion may originate from the traditions, the geographic characteristics concerning the production of these foods, or the organic feature of their production.
Form the producer's point of view, the special foods opens the possibility to satisfy special consumer demands, and thus it is suitable for filling market gaps (niche) due to its small

volume. As a result, the producer is not subjected to the principles and rules of scale intensity and economy of scale.

3. NICHE MARKETING

Segmentation is the identification of groups of persons or organizations of identical characteristics, which significantly influence the determination of different marketing strategies. The kaleidoscopic market is divided into smaller, homogeneous submarkets to identify and effectively supply the consumer groups with identical demands.

Different products have to be offered to the different groups to realize marketing concept and to satisfy consumer demands. If we manage to identify the consumer groups with similar needs, their demands can be satisfied more effectively. Segmentation lays emphasis on consumer satisfaction forward; markets have different structures of demands. These have to be examined and finally known thoroughly and adapting to the results, the decent services have to be offered. A company adapts its marketing plan to the needs of the target group in order to satisfy them at its best.

Market segment is a larger, identifiable part of the market. A market spot is a narrowed group of the market, which is determined by the segmentation of market segments or by the group of such clients who expect certain unique advantages from the purchase.

Niche can be considered as a small market, which consists of a customer, or of a small group of customers who have similar characteristics and demands. Niche can be defined as a circle of clients or market segment which has been created by considering the objectives of the enterprise, and must be highly homogeneous considering the features which are important for the firm. It must be well-separable from other niches and have a decent size (to make profits above the cost), and also has to be well accessible for the company.

The general features of niches can be determined as follows:

- the group of customers belonging to the market spot has a characteristic and distinguishable structure of needs;
- customers are willing to pay even more for that company, which satisfies these demands the best;
- the company supplying the spot has the abilities required for high quality supply of this group;
- the company gains advantage from specialization;
- it is not probable that the niche will draw others, but even in this case the owner of the niche can defend its positions;
- the spot has a considerably high scale-, profit- and growth potential.

Focused marketing, expedient marketing, concentrated marketing can also be used as synonyms for niche marketing.

In case of niche marketing, the company concentrates on a single niche market. Niche marketing can help companies to remain among the healthy survivors. Those firms, which

intend to survive, expand and gain profits may be obliged to find such kind of markets which are:

- sufficient size to be potentially profitable,
- no real competitors, or markets which have been ignored by other companies,
- growth potential,
- sufficient purchasing ability,
- a need for special treatment,
- possess appropriate clientele (Kotler,1991).

In case of niche marketing, two attitudes can be distinguished:

1. To see niche marketing as a creative process, as Chalasani and Shani (1991) termed „nichemanship" which is a process of carving out a small part of the market whose needs are not fulfilled. By specialization along market, customers, product or marketing mix lines, the company can match the unique needs.
2. To see niche marketing as a last stage of segmentation, taking place in the following sequential stages: segmentation, targeting, positioning and niching (Keegan,1992).

Kotler suggests that the key idea in niche marketing is specialization and he provides the following ways in which to specialize:

- end-user specialization,
- vertical specialization,
- customer-size specialization,
- geographic specialization,
- product or product-line specialization,
- product-feature specialization,
- „job-shop" specialization,
- quality/price specialization,
- service specialization,
- channel specialization.

Kotler's idea of specialization leads us to the distinctive competencies a firm needs to possess to pursue niche markets. (Kotler, 1991). According to Pavitt, innovating small firms are typically specialized in their technological strategies, concentrating on product innovation in specific produced goods. Their key strengths are in their ability to match technology with specific manufacturing requirements (Pavitt, 1990).
Under today's market conditions, even non-profitable segments can become attractive as the effectiveness of marketing enhances. Effective marketing work is a key element of the spreading and evolution of niche marketing. It is of utmost importance that we could create such kind of demand towards our product, which can be best satisfied by us, and we can also protect it from competitors. Clients should be arranged in networks, draw them into service-, product- and corporal development, thus gaining satisfied and loyal customers. In niche marketing the focus is on the customer and on profit; niche marketers specialize in serving marketing niches. Instead of pursuing the whole market (mass marketing), or large

segments of the market, these firms target segments within segments or, for the sake of simplicity, niches (Blattberg and Deighton, 1991).

Due to the above-mentioned features, the company present in niches is able to get to know the targeted customers thoroughly, and also able to fulfil their demands better than anyone else, since it can tailor its products for the niches. As a consequence, the company specializing in the niche can realize significant profits over its cost, because the price judgement of the market accepts this. While the firm specialized in a niche can gain profits from high margins, a mass producer realizes its profits from the high volume of its goods.

Niche marketing fulfils best the basic principle that profit objectives served by marketing can be best achieved by serving the customer. The advantages of niche marketing are rather obvious resulting from the previous aspect. Based on niche orientation, a rational product- and assortment-structure can be formed, since the survey and service of the homogeneous clientele works more effectively. The target group can be easily stabilized; the uniqueness of the firm and its profit-generating image becomes stronger. The risks can be better measured and reduced due to the safer decisions, which can be better grounded. By increasing goodwill, the sale conditions can be gradually rendered more and more favourable and in most cases, also the size of the niche can be increased. Based on well-ground knowledge, new and new products can be developed for the niche, although this is also a must, since the competitors are ready to conquer the niche. Other elements of the marketing mix change as well. More effective marketing channels can be created, the strategy of pricing might have more freedom and also significant savings can be achieved in the costs of marketing communication.

4. THE APPLICATION OF THE NICHE MARKETING STRATEGY

Change in macroeconomic forces transforms marketing strategies. As a consequence, it is not enough to do things better and quicker; companies are forced to work out new marketing tricks and practices (Sheth, 1992).

There are many reasons why the American and European mass markets had been segmented since the Second World War, and these reasons (Linneman and Stanton, 1991, McKenna, 1988, Rapp and Collins, 1990) led to the fecundity of smaller markets:

- single-parent households, families with double income and no children (dinks), yuppies,
- working women, overweight people,
- increasing minority markets,
- technological advances,
- the evolution of consumer countervailing power,
- changing demographics and lifestyles,
- the demands on personal time,
- overcrowding by too many products, services and stores,
- the decline in brand loyalty,
- spreading of turmoil and aggression,
- increasing possibilities for discount purchases.

According to Leeflang, niche strategy is chosen by companies in case the following circumstances are present:

- If the company concerned has the ability to approach a niche in a specific manner, better and different than others.
- If the company is able to create a considerable amount of goodwill in a relatively short period, in order to deter potential competitors (Leeflang, 1990).

It is stated by many that niche marketing is applied only by small firms, however a significant part of medium- and large companies also apply it since the great added value results in high profits. This is supported by a study from Linneman and Stanton, which was published with the title „Profit Impact of Marketing Strategy" (PIMS) by the Strategic Planning Institute. Hundreds of business units have been examined regarding the profit gains in different business sectors. After the evaluation of the results, the survey states that the mean profits of investments on larger markets were around 11 %, while in case of small markets they found it 27 % (Linneman and Stanton, 1991). This result also proves the effectiveness of the application of niche marketing strategy both in the case of small- and medium-size companies.

In the following, we are going to summarize the most important basic principles which can help a company in the realization of a successful niche marketing strategy:

- Know your company's strengths and weaknesses, its uniqueness, competitive advantages, distinctive competences, regional and traditional characteristics
- To be able to focus on specific niches or customer groups, exact information is needed on these customers. The key to getting to know the customers is through talking and listening to them.
- The products of the competitors must be known, and a way has to be found that our customers choose our products and not that of the competitor's.
- Unique advantages must be offered for the customers, they can access only this way real values.
- High entrance limits has to be set for the competitors, like trademarks, patents, collective activities.
- It is vital to constantly monitor market changes and react to them.
- The number of possibilities has to be increased, it is necessary to think and act on new fields all the time.
- It has to be determined how we could convince to buy our products those, who are currently using a competitor's product. This can be done by giving new meaning to our marketing offer, or by its repositioning.

Niches can not be developed as individual markets, they must be connected to cooperate and provide efficiency. The base of the activities in a market segment is the specialization, which has many possible ways, for example specialization in a unique, specific product. Since these kinds of products are unique, their general feature is that their production requires a large amount of live workforce, which is also realized in their prices as well. By

this group of products prices excess by far the prices of mass produced goods. Their further feature is that they are produced in relatively small amounts. A frequent misunderstanding is that a certain scale limit always has to be fulfilled, since under a certain quantity sale promotion and reaching the loyalty of the customers would be hopeless tasks.

5. THE COLLECTIVE MARKETING WORK

The appeal of niche products necessitates the creation of a new collective marketing concept.
A tool of utmost importance for niche marketing is the collective marketing activity itself. The collective form of marketing offers many advantages for the enterprises, since they can work more effectively by carrying out some important tasks together (e.g. market research, advertising, distribution politics, product policy) while their corporal independence remains unaffected. Cooperation usually means incorporation and coordination – among independent companies - of identical subtasks.
Collective marketing activity – with the participation of numerous food industry enterprises – plays a very important role in the shaping and balancing of the domestic market, and export.

More and more small- and medium-sized firms recognizes the necessity of active adaptation to changing market conditions, but can not take the appropriate steps on their own. Thus the need for cooperation emerges which means the cooperation between companies in a collective, integrated form. Collective marketing applies the traditional methods and tools of marketing, since the target group of the marketing work is the same as in the case of corporate marketing. Collective marketing can be widely connected to the individual marketing activity of the firms, but in cooperation greater success can be achieved as working separated.
Collective marketing has an important role in the preparation of producers and traders to possess appropriate market information, thus becoming competitive. The program of collective marketing above all deals with the collection, processing and sending of market information. Cooperatives play an outstandingly positive role in providing unique and constant product quality, in the delivery of market information and in the spreading of modern attitude to marketing.

Since the '70-es, the concentration of the food trade has been continuous. Nowadays, almost in every country of the European Union, only a few trading partners possess more than 80 % of total turnover. This concentration resulted in the affirmation of the buying up position of trade with all those consequences which affect the players at inferior levels. If bid-makers want to be competitive, then it is necessary that they cooperate, integrate even on the level of food economy or agriculture. Collective marketing has to prepare for the consequences originating from the afore-mentioned conditions. The exact determination of the goals which are to be reached by collective agricultural marketing is quite important. The most important objectives are:

- creating preferences for agricultural products,
- providing market areas,
- providing the user level directing to traditional products,
- innovation of new products,

- provision of high quality standards,
- provision of marketing channels,
- strengthening the competitiveness of domestic bid-makers,
- protection of the domestic market (Gaál, 2004).

To realize the collective marketing objectives, application of collective marketing tools is necessary. The first place on the importance list stands the communication policy. Products (and even niches) must be made attractive even at home and abroad with the methods of advertising and sales promotion. The role of public relation is also significant: the press releases on food supplies represented by the collective marketing agency must be re-actuated. Product policy has to take care that the attractive products should appear in the market supply. The given product must possess quality proofs, for example in case of the purchase of bioproducts, consumers are oriented by reliability and guarantees of the applied bio-labels. In the building and maintenance of consumer confidence, the product indicators play a key role. Moreover, collective marketing must support the development of appropriate marketing channels (distribution policy), through which foods can succeed. Of course, the application of different marketing tools has to be based on extensive and intensive market research; this provides the data required for planning to the collective marketing institutions and also data on the efficiency and control of the tools which can be applied on the examined markets.

Unfortunately, collective marketing activity has hardly begun in Hungary. But it would be a glaring blunder if – based on the controversial experience from the recent years – we'd give up the intentional development of the country-region-product image system at a time when exactly this activity group – among others, to the effect of the WTO-deal – gets more and more attention in every developed country.

6. CONCLUSION

On the saturated food market, the phenomenon of oversupply seems to prevail. Thus, the application of differentiating strategy has utmost importance. Such kinds of unique, special products are needed which – in special fields - offers more, better quality, or something special to the customers. This speciality can originate from the traditions, the geographic characteristics concerning the production of these foods, or the organic feature of their production. Hungary possesses some of these unique products of outstanding quality, which result in the practical realization of niche marketing.

For small- and medium enterprises, the application of niche marketing offers a possibility to break out from the shadows of the multinational companies. Consumer demand for special food increases continuously and the rapidly changing needs can be best fulfilled by the small- and medium firms which are able to react very quickly to these changes. The production of special foods results greater added value for the enterprises, and as a regional concern it helps rural development. It can contribute to the population-withdrawing effect of the regions and indirectly contributes to rural tourism. The added value, which remains in the region increases local consumption via local restaurants, gastronomic festivals and cultural, tourist programmes. Also results in a significant increase in the number of workplaces and makes possible the starting of local enterprises, thus hindering the depopulation of rural areas.

Small enterprises can not conduct the all-round marketing activity by themselves, thus their cooperation is expedient and advantageous. The participants of the collective marketing activity retain their independence in their base activities, but in case of certain tasks, they can divide the cost among each other.
Possibilities which are available nowadays can only be exploited optimally if we use every tool to create the different form of cooperation and to strengthen the willingness to cooperate.

REFERENCES

1. Chalasani S.-Shani D. (1994): Exploiting Niches Using Relationship Marketing, The Journal of Consumer Marketing, Vol 9 No.3, 33-42.p.
2. Gaál Béla (2004): A magyar közösségi agrármarketing és az EU-csatlakozás (271-287.p.) In Berács- Lehota – Piskóti – Rekettye: Marketingelmélet a gyakorlatban Budapest, KJK Kerszöv Kft.
3. John Williams (2007): Target the right niche. http://www.entrepreneur.com/marketing/branding/imageandbrandingcolumnistjohnwilliams/article178964.html
4. Kathy Ellis (2003): Niche-based marketing. http://www.allbusiness.com/marketing/direct-marketing/222761-1.html
5. Keegan W. (1992): Marketing, Prentice-Hall, Englewood-Cliffs, NJ.
6. Kim T. Gordon (2002): 3 rules for niche marketing. http://www.entrepreneur.com/marketing/marketingcolumnistkimtgordon/article49608.html
7. Magyar Zoltán (2006): A niche marketing, mint potenciális kisvállalati stratégia. Pannon Gazdaságtudományi Konferencia tanulmánykötet II., Veszprém.
8. Kotler P.(1991): From Mass Marketing to Mass Customization, Planning Review, September/October 1991, 11-47.p.
9. Leeflang, P.S.H.(1990):" Market Segmentation", unpublished European Business Studies Seminar.
10. Pavitt K. (1990): What we know about the Strategic Management of Technology, California Management Review, 17-26.p.
11. Robert Blattberg-John Deighton (1991): Interactive Marketing Sloan Management Review 33/1.
12. Robert E. Linneman-John L. Stanton Jr.(1991): Making Niche Marketing Work: How to Grow Bigger by Acting Smaller New York.
13. Sheth N.J.(1992): Emerging Marketing Strategies in a Changing Macroeconomic Environment: A Commentary, International Marketing Review, Vol 9 No.1, .57-63.p.
14. Tevfik D.- Maarten L. (1994): Niche Marketing Revisited: Concept, Applications and some European Cases, European Journal of Marketing 28, (4), 39-55.p.

RETAIL STORAGE OF PEELED, HARD-BOILED WHOLE EGGS

Péter Ozsváth [a], Csaba Németh[a], László Friedrich[a], Klára Pásztor-Huszár[a], Zoltan Németh[b], Kinga Horváth[a], Csilla Vén[a], Csaba Balla[a]*

[a]Corvinus University of Budapest, Faculty of Food Science, Department of Refrigeration and Livestock Products Technology, Budapest, H-1118, Ménesi út 43-45, Hungary

[b]Faculty of Agricultural and Environmental Sciences, Institute of Botany and Eco-Physiology Gödöllő, H-2100, Páter Károly út. 1.

e-mail: csaba.nemeth@uni-corvinus.hu

ABSTRACT

The use of peeled hard-boiled whole eggs is widespread in the industry; however its retail trade is hindered by many factors. The most important is the complicated preservation of egg which due to its complex composition is an excellent medium for micro-organisms. Maintaining the colour, taste and aroma characteristic of fresh, boiled eggs during storage generates further problems. In our study we searched for a packaging method that ensures the safe home cool storage of peeled hard-boiled whole eggs and keeps egg quality. In our experiments the peeled hard-boiled whole eggs were vacuum-packed, packed into protective gas or stored at cool temperature after immersing them in salty, with citric acid acidified liquid. Having examined the changes during cool storage in the samples packed in various ways we found that if a product with shorter shelf-life is satisfactory, the use of protective atmosphere is advisable. However when it is necessary to ensure the shelf-life longer than 14 days, this could be achieved by eggs stored in acidified brine.

1. INTRODUCTION

In these days cold kitchens and restaurants prefer to use peeled hard-boiled whole eggs instead of raw shell eggs (Stadelman & Cotterill, 1995). The reason is that hard-boiled eggs are homogenous in quality and in appearance, are easy to use and are free from the strongly faeces-contaminated shell, which means food safety risk (Moats, 1980). Further advantage is that during cooking at a temperature higher than 90°C (Hale et al, 1981) most of the heat-sensitive bacteria (Adams & Moss, 1995) in eggs causing deterioration are destroyed (Stadelman et al., 1982) as well as *Salmonella* that possesses similarly low thermal resistance (Jin et al., 2008).

In spite of their advantageous properties peeled hard-boiled whole eggs cannot be purchased from retail trade, they are only available in packaging intended for big consumers (60-90 pc/pack). However the changes in consumer demands, through the increased use of convenience foods, have brought the development of boiled egg products which are quick and ease of use in the households into limelight (Stadelman et al, 1988).

Important criteria for peeled hard-boiled whole egg getting into retail are to maintain the advantageous properties of fresh product, to be easy to store as well as to be suitable from food safety point of view (Harrigan & Park, 1991).

One option for retail of hard-boiled eggs is their storage in salty water with reduced pH, similarly to products intended for further industrial processing. In such a „brine" even a pH value of about 4,5 can be adjusted to inhibit bacterial agents (McMeekin et al., 1993) i.e. the pickled product keeps its harmonious taste due to the added salt.

The other possibility is the storage of hard-boiled eggs in modified atmosphere or vacuum packaging. According to literary data the shelf-life of peeled hard-boiled whole

eggs can be significantly extended in a CO_2 containing atmosphere for the reason that eggs release CO_2 more slowly (Feiser & Cotterill, 1982), thus their acidity decreases to a lesser extent during storage (Brooks & Pace, 1938). Beside keeping quality the oxygen-free packaging either by modified atmosphere or by vacuum inhibits the multiplication of aerobe micro-organisms (Prescott et al, 1993).

In our research hard-boiled egg products in retail packages were stored in refrigerator at 4°C and microbiological, pH, sensory and colour examinations were carried out to determine changes during storage.

2. MATERIALS AND METHODS

Fresh eggs were purchased from a Hungarian egg producer. The eggs were boiled for 10 minutes at 95 °C, then shells were removed manually using sterile gloves. The peeled hard-boiled whole eggs were put into vacuum or gas (50-50% N_2 and CO_2) packaging or to a container filled up with 1% salt solution acidified to pH 4,5 by citric acid. The eggs packaged in various ways were refrigerated at 4°C in the same way (Stadelmanet al, 1982).

Viable cell counts were measured in triplicate and the presence of *Salmonella* was monitored on selective culture media weekly. In the case of *Salmonella* detection the peeled hard-boiled eggs were homogenized and 25 g of them was enriched on Rappaport selective medium for 24 hours after a 24-hours peptone water pre-enrichment. Subsequently streaking was carried out on bismuth-sulfite, BPL and XLD selective media. Incobution were carried out in the case of the viable cell counts determination for 48 hours at 30°C, and in the case of *Salmonella* detection for 48 hours at 37°C.

The pH value of eggs was tested weekly. It was carried out by SENTRON pH meter, with insertion pH electrodes, excellently suitable for testing hard-boiled eggs. In every case measurements were made at 3 different points in triplicate.

Colour tests were achieved by Minolta ChromaMeter CR-200 type colorimeter suitable for tristimulus reflexive colour measurement and also 3 samples were examined at 3 points weekly.

Sensory analyses were made to carry out a group of 15 people of variable age and gender. The questioned properties were taste, odour and texture on a ten graded scale, where 10 meant the characteristic sense of a fresh, hard-boiled egg, while 1 referred to a totally different sense from this. Tasting was carried out only in case of acceptable microbiological results.

3. RESULTS

The bactericide effect of the various storage methods may be different due to the pH value developing in the eggs. While vacuum and protective gas packaging influences the pH value of samples only to a small degree, the acidified salty water quickly and significantly modified it.

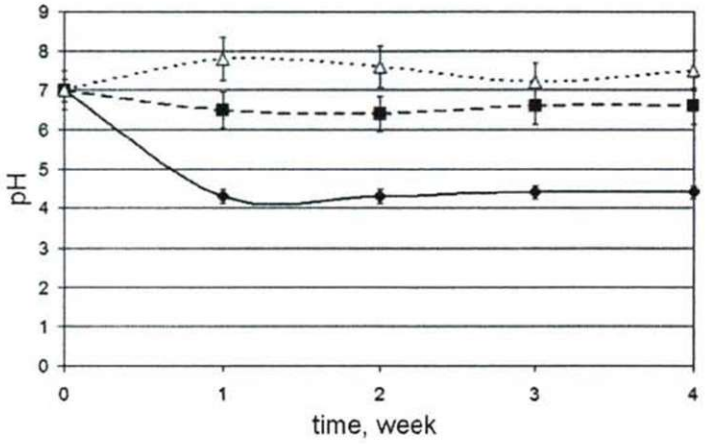


Figure 1. Change in pH values of hard-boiled eggs

♦ Hard-boiled whole eggs in salty liquid, ■ Hard-boiled whole eggs in protective gas, △ Hard-boiled whole eggs in vacuum

Figure 1 shows that while the pH values of vacuum-packed samples slightly increased that of samples packed into protective gas in fact remained unchanged.

In the case of vacuum packed samples the slight rise in pH values was probably due to the release of CO_2 resulted from the dissociation of carbonic acid. This process was inhibited by the protective gas with a 50 % of CO_2 concentration which prevented carbonic acid from dissociation.

Eggs stored in acidified brine adopted its pH value at the end of the first week, and pH remained unchanged during our experiments.

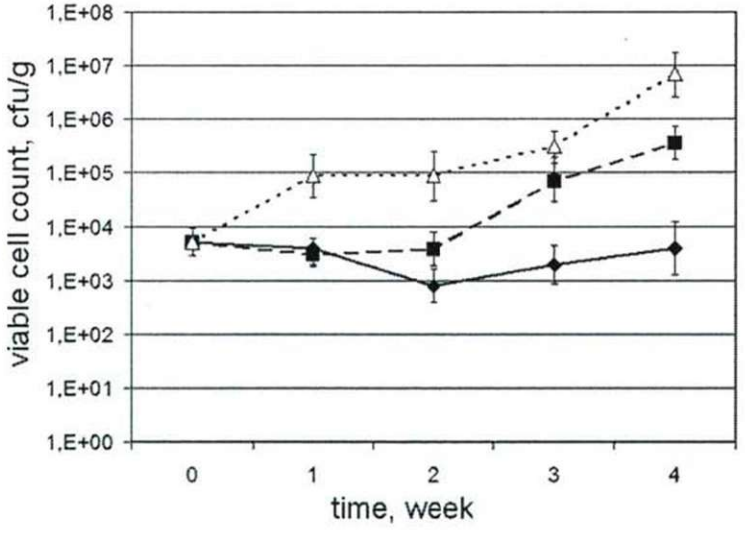


Figure 2. Change in viable cell counts of hard-boiled eggs

♦ Hard-boiled whole eggs in salty liquid, ■ Hard-boiled whole eggs in protective gas, △ Hard-boiled whole eggs in vacuum

As it can be seen from Figure 2 the fastest increase in viable cell counts was in the case of vacuum-packed cool stored hard-boiled whole eggs. In these samples even in the 1st week about 10^5 cfu/g value was measured, which is the food safety limit related to egg products.

In samples stored in salty, pH-reduced liquid or protective gas no significant increase in viable cell counts was found up to the second week. Subsequently the viable cell counts of eggs stored in protective gas increased relatively quickly.

The changes in viable cell counts of eggs stored in acidified brine remained insignificant during our examinations, and at the end of the experiment the value obtained in these samples was similar to the initial one.

During the 3 weeks of the experimental storage time no *Salmonella* was detected in any of the samples packed in the various ways.

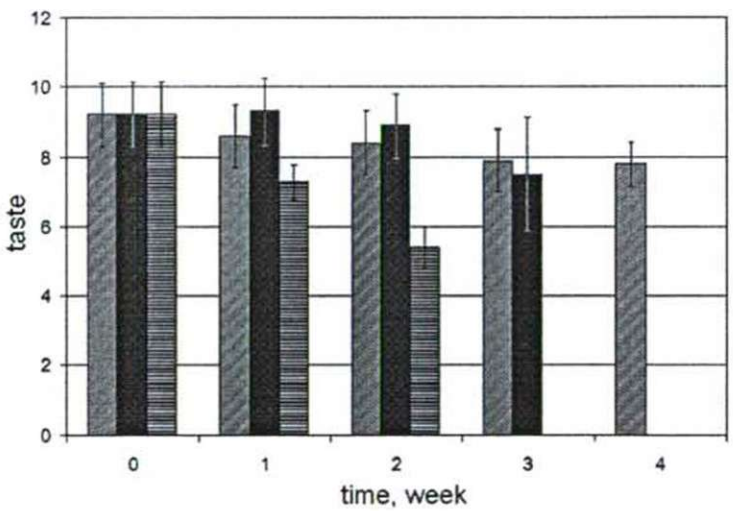


Figure 3. Tendencies in taste of hard-boiled egg
Hard-boiled whole eggs in salty liquid, Hard-boiled whole eggs in protective gas, Hard-boiled whole eggs in vacuum

From Figure 3 it can be concluded that up to the 2nd week the taste of cool stored, hard-boiled, peeled whole eggs packed in protective gas (50-50% N_2 and CO_2) was the most adequate according to the tasters. However between the 2nd and the 3rd week relatively large deterioration in taste could be observed. In the fourth week tasting were not carried out due to the microbiological risk.

In the eggs stored in acidic salty liquid from the second week a relatively small change in taste was found. The only exception was the slightly acidic effect in taste. However when the eggs stored in salty liquid were used according to the intended

application method (egg salad, slice into sandwich) the tasters could not distinguish fresh and stored eggs.

The taste of vacuum packed, peeled, hard-boiled eggs was the least favourable, it degraded even to the second week.

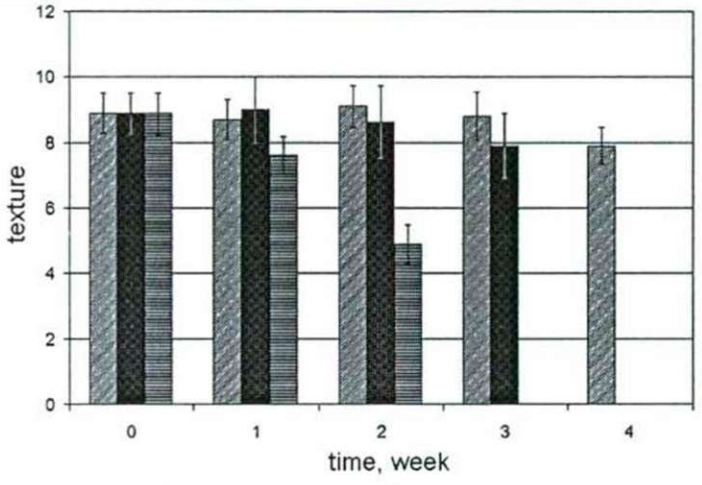


Figure 4. Change in the texture of boiled eggs

Hard-boiled whole eggs in salty liquid, Hard-boiled whole eggs in protective gas, Hard-boiled whole eggs in vacuum

The texture of eggs stored cool in acidified brine remained unchanged up to the first three weeks, only to the fourth week deteriorated to some extent according to the tasters (Figure 4). The texture of eggs stored in protective gas packaging also showed favourable tendency. The texture of vacuum-packed eggs deteriorated quickly and from the second week an unpleasant texture was found at consumption.

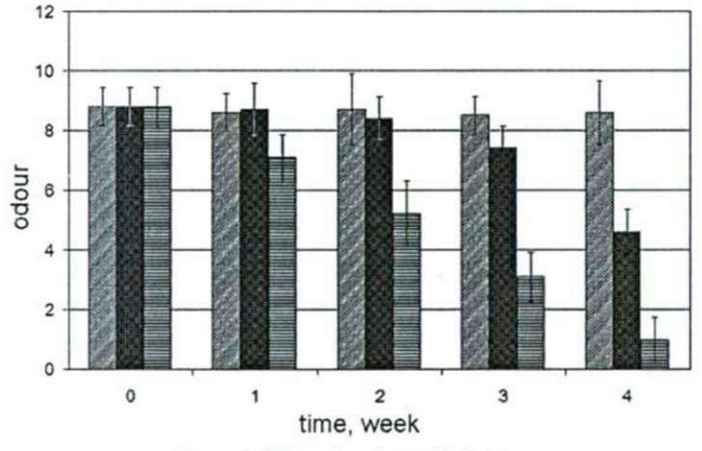


Figure 5. Change in odour of boiled eggs

Hard-boiled whole eggs in salty liquid, Hard-boiled whole eggs in protective gas, Hard-boiled whole eggs in vacuum

The characteristic odour of peeled, hard-boiled, whole eggs (Figure 5) was particularly maintained in the acidified salty liquid. Applying this storage method the samples maintained the odour of fresh, hard-boiled eggs during our experiments.

During the first two weeks of storage the odour of eggs stored in protective gas compared with that of samples stored in salty liquid showed similar favourable tendency. In the second week samples stored in CO_2-N_2 gas mixture possessed approximately identical "smell-attributes" than freshly boiled eggs. Subsequently, however, significant change occurred in odour, which can probably be justified by the change in microbiological status.

The odour of vacuum-packed eggs significantly changed even in the first two weeks of storage and for the last two weeks of our experiments these samples particularly smelled as a "rotten egg".

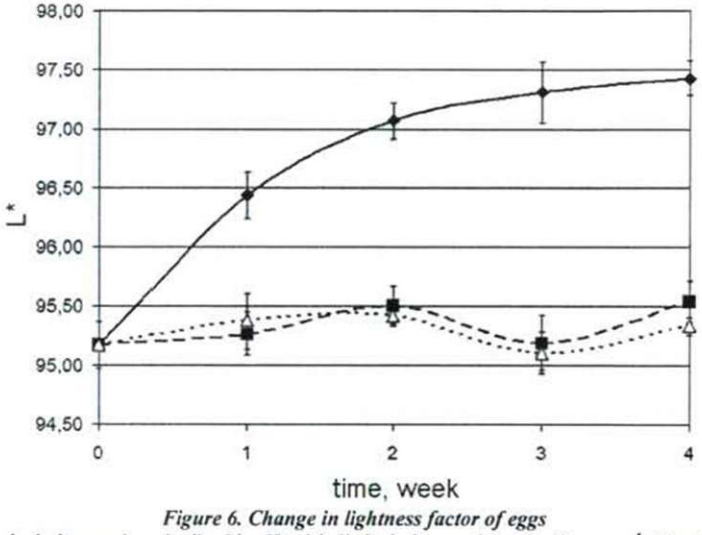


Figure 6. Change in lightness factor of eggs
♦ Hard-boiled whole eggs in salty liquid,■ Hard-boiled whole eggs in protective gas, △ Hard-boiled whole eggs in vacuum

Figure 6 shows that while in terms of extent and progress similar changes occurred in the surface of both vacuum packed and protective gas packaged products concerning the lightness factor (L*), of eggs stored in salty liquid difference was found.

These differences could be observed even in the first week. The surface of eggs slightly, perceptible with senses faded in salty liquid. These changes however did not give an unpleasant impression about eggs stored in salty liquid.

4. DISCUSSION

Our results show that vacuum packed eggs not just have a short shelf-life but quickly loose sensory attributes characteristic of fresh hard-boiled eggs.

Sensory attributes of samples stored in both acidified salty liquid and in protective gas packaging were more favourable. The taste and colour of eggs stored in N_2-CO_2 gas

mixture were more favourable during the 1st two weeks, but their shelf-life proved to be significantly shorter taking into account relevant food safety and quality criteria. While the total plate count of peeled, hard-boiled, whole eggs in the case salty, with citric acid acidified water of in terms of the order of magnitude remained the same all along our experiments, the samples stored in protective gas packaging deteriorated up to the fourth week.

According to our studies the hard-boiled eggs packaged in protective gas is recommended for such consumers (small shops, buffets), who consider the natural colour of eggs important or their stock changes quickly. When hard-boiled eggs are used for further processing or they can be to stored for longer time it is advisable to select storage in acidified salty liquid.

REFERENCES

1. Adams, M. R., Moss, M. O. (1995): Chapter 7: Food Microbiology, Bacterial Agents of Foodborn Illnesses, The Royal Society of Chemistry.
2. Brooks, J., Pace, J. (1938): The distribution of carbon dioxide in the hen's egg, Proc. Royal. Soc. London, Ser.B. 126,196-210.
3. Feiser, G.E., Cotterill, O.J. (1982): Composition of serum from cooked-frozen-thawed-reheated scrambled eggs at various pH levels, J. Food. Sci., 47, 1333-1337.
4. Hale, K.K., Potter, L.M., Martin, R.B. (1981): Firmness and microbial quality of hard-cooked eggs stored in critic acid, Pult. Sci. 60, 1664.
5. Harrigan, W.F., Park, R.W.A. (1991): Making safe food, Academic Press, London.
6. Jin, T., Zhang, H., Boyd, G., Tang, J. (2008): Thermal resistance of Salmonella enteritidis and Eschericha coli K12 in liquid egg determined by thermal-death-time disk, Journal of Food Engineering 84, 608-614.
7. McMeekin, T.A., Olley, J.N., Ross, T., Ratkowsky, D.A. (1993): Predictive Microbiology, Research Studies Press Ltd., Taunton.
8. Moats, W.A. (1980): Classification of bacteria from commerical egg washers and washed and unwashed eggs, Appl. Environ. Microbiol., 40,710-714.
9. Prescott L.M., Harley J.P., Klein D.A. (1993): Microbiology, Chapter 15: Control of Microorganisms by Physical and Chemical Agents, WCB Publishers.
10. Stadelman, W.J., Cotterill, O.J. (1995): Egg science and technology, Food Product Press.
11. Stadelman, W.J., Ikeme, A.I., Roop, R.A., Simmons, S.E. (1982): Thermally processed hard cook eggs, Poult. Sci. 38, 1253-1254.
12. Stadelman, W.J., Olson, V.M., Shemwell, G.A., Basch, S., (1988): Egg end Poulty Meat Processing, Ellis Horeood Ltd, Chichester, England.
13. Stadelman, W.J., Ikema, A.I., Roop, R.A., Simmons, S.E. (1982): Thermally processed hard-cooked eggs, Poult. Sci. 61, 388-391.

INVESTIGATION OF CAR ENGINES EMISSION CONTROL

Alfredas Rimkus
Department of Automobile transport, Vilnius College of Technologies and Design
Olandu str. 16, LT-01100 Vilnius, Lithuania,
e-mail: rimkus_a@yahoo.com

ABSTRACT

Automobile exhaust gases significantly pollute the environment. Pollution decreases the modern electronic engine management system. Exhaust gas emissions due to correct the engine management system work. Management system failures identify the diagnostic aid. Automobile diagnostics is one of the main subjects in training cars service specialists in Vilnius College of Technologies and Design. The diagnostics subject consists of theoretical and practical training. Various types of engine management systems work and their faults are investigated in the laboratory. The main equipment consists of engine simulators. The development of using microprocessing technologies in automobile control requires more sophisticated diagnostics equipment. Most developing diagnostics equipment are systemic testers which take the information from the electronic control unit (ECU) about trouble codes' and display working parameters. However we can only see real sensors' signals by having direct contact. Students are measuring engine management signals in the laboratory by using an electricity signals input bloc. On the screen of the PC we can see the electronic management signals graphics image. The signals are analyzed and that is how the faults are diagnosed. Experience of automobile electronic management signals research is necessary for the students in their practical work of automobile diagnosis.

Keywords: Automobile diagnosis, exhaust gas, oxygen sensor, electric signal.

1. INTRODUCTION

Automobile mechatronic systems are recently the most developing automobiles field. New generation automobiles electronic control's units (ECU) are now controlling many systems and mechanisms, such as engines, gear boxes, brakes systems and so on. Various types of engines and others mechanisms management systems work and their faults are investigated in the laboratory. The main equipment consists of mechanism's simulators. The development of using microprocessing technologies in automobile control requires more sophisticated diagnostics equipment. Most developing diagnostics equipment are systemic testers which take the information from the ECU about trouble codes' and display working parameters. However we can only see real sensors' signals by having direct contact. Students must measuring mechanism's management signals in the laboratory by using an data acquisition device "E-Biol". On the screen of the PC we can see the electronic management signals graphics image. The signals are analyzed and that is how the faults are diagnosed. Experience of automobile electronic management signals research is necessary for the students in their practical work of automobile diagnosis.

2. OVERALL EQUIPMENT AND SOFTWARE REQUIREMENTS

For the investigation of the operation of engine management's system is used Toyota engine 2NZ-FE simulator (see Figure 1).

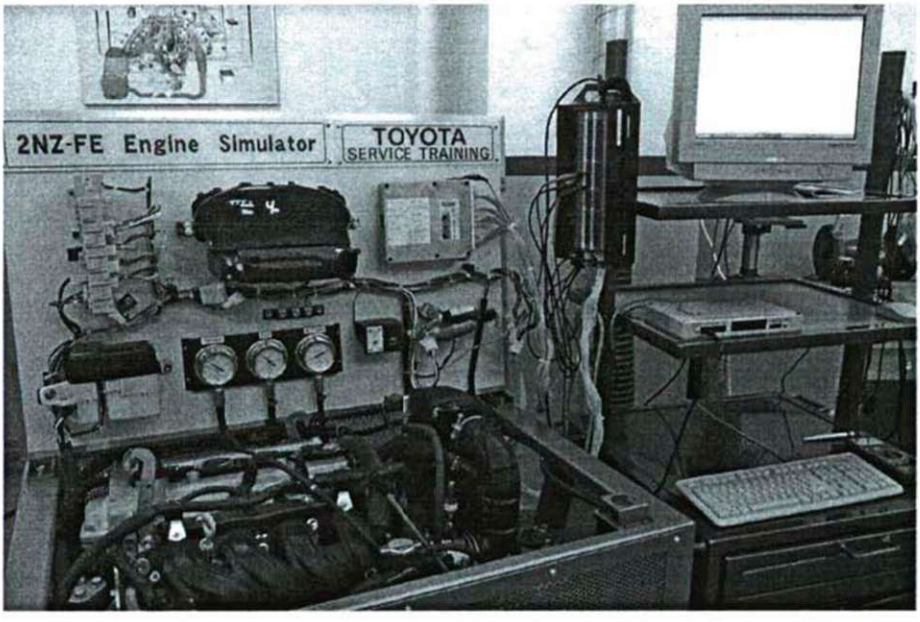


Figure 1. Engine 2NZ-FE simulator

Engine control system uses an ECU with a built-in microprocessor (see Figure 2).

The ECU utilizes these data and signals from the various sensors in the vehicle and makes calculations with the stored programs to determine fuel injection duration, ignition timing, idle speed, etc., and outputs control signals to the respective actuators which control operation (see Figure 3).

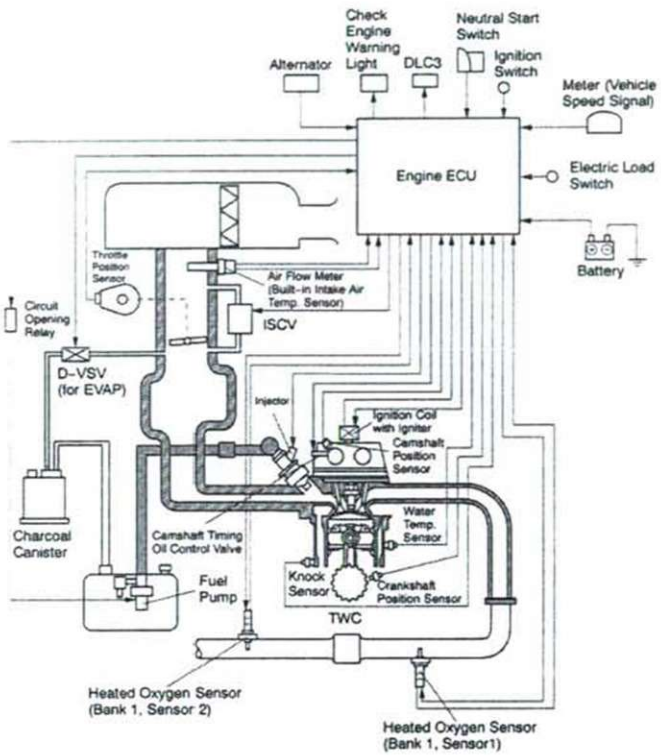


Figure 2. Engine 2NZ-FE computer controlled system diagram

1. EFI (Electronic Fuel Injection)
2. ESA (Electronic Spark Advance)
3. ISC (Idle Speed Control)
4. VVT-i (Variable Valve Timing-intelligent)
5. FUEL PUMP CONTROL
6. OXYGEN SENSOR HEATER CONTROL
7. EVAPORATIVE EMISSION CONTROL
8. ENGINE IMMOBILIZER
9. DIAGNOSIS
10. FAIL-SAFE

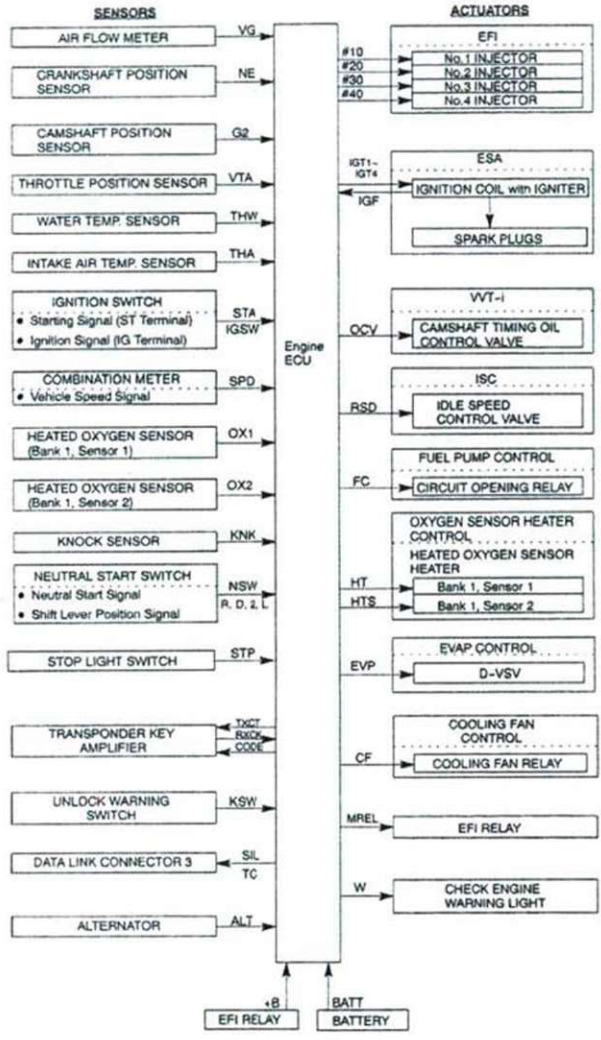


Figure 3. The configuration of the engine control system

With the break-out box (Figure 4) installed on the simulator it is possible to pass electronic signals to inputs of data acquisition block "E-Biol". The break-out box consists primarily of male and female connectors that connect to the engine ECU terminals and the terminal measuring probe. The terminals for inserting the probes of an electrical tester "E-Biol" are provided on the break-out box in order to measure voltage or resistance.

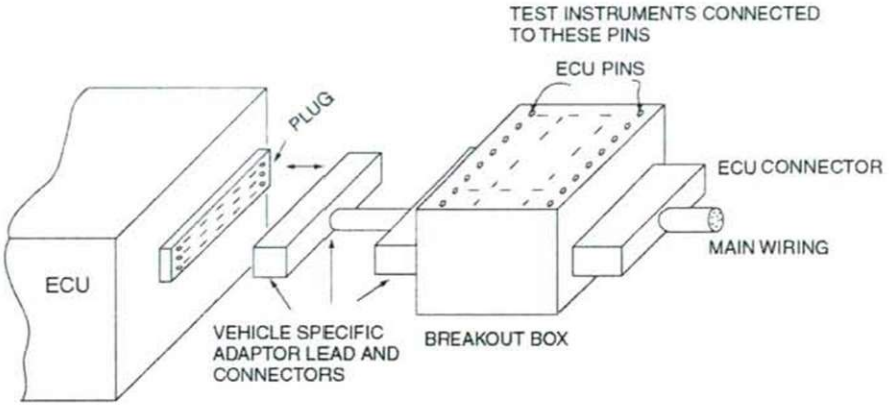


Figure 4. A breakout box

3. INVESTIGATION OF OXYGEN SENSORS' SIGNALS

To obtain a high purification rate for the CO, HC and NO_x components of the exhaust gas, a three-way catalytic converter is used:

$$2CO + O_2 \rightarrow 2CO_2$$
$$2NO + 2CO \rightarrow N_2 + 2CO_2$$
$$2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$$

For the most efficient use of the three-way catalytic converter (see Figure 5), the air-fuel ratio must be precisely controlled so that it is always close to the stoichiometric air-fuel ratio ($\lambda = 1$).

$$\lambda = \frac{actual\ air - fuel\ ratio}{cemiclly\ correct\ air - fuel\ ratio\ (14{,}7:1)}$$

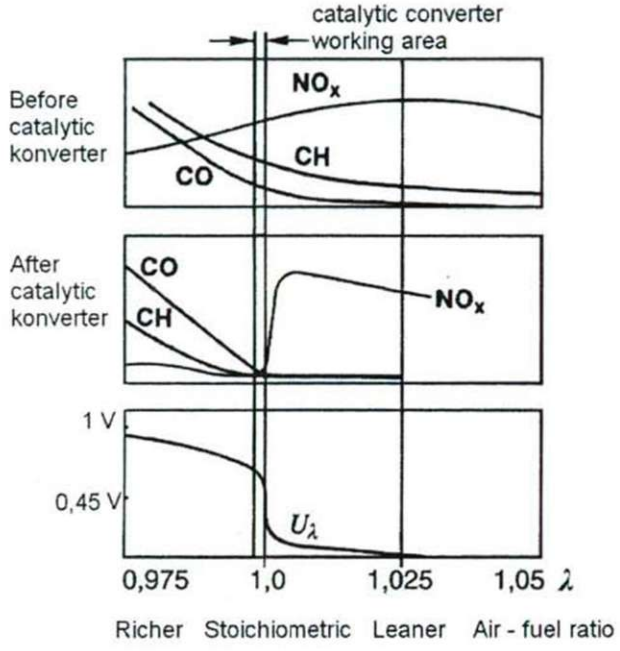


Figure 5. Catalytic converter work efficiently

The oxygen sensor has the characteristic whereby its output voltage changes suddenly in the vicinity of the stoichiometric air-fuel ratio. This is used to detect the oxygen concentration in the exhaust gas and provide feedback to the computer for control of the air-fuel ratio. When the air-fuel ratio becomes LEAN, the oxygen concentration in the exhaust increases and the oxygen sensor informs the engine ECU of the LEAN condition (small electromotive force: $U_\lambda < 0.45$ V).

When the air-fuel ratio is RICHER than the stoichiometric air-fuel ratio the oxygen concentration in the exhaust gas is reduced and the oxygen sensor informs the engine ECU of the RICH condition (large electromotive force: $U_\lambda > 0.45$ V). The engine ECU judges by the electromotive force from the oxygen sensor whether the air-fuel ratio is RICH or LEAN and controls the injection time accordingly.
However, if a malfunction of the oxygen sensor causes an output of abnormal electromotive force, the engine ECU is unable to perform accurate air-fuel ratio control.

The main heated oxygen sensors include a heater which heats the zirconia element (see Figure 6). The heater is controlled by the engine ECU. When the intake air volume is low (the temperature of the exhaust gas is low) current flows to the heater to heat the sensor for accurate oxygen concentration detection.

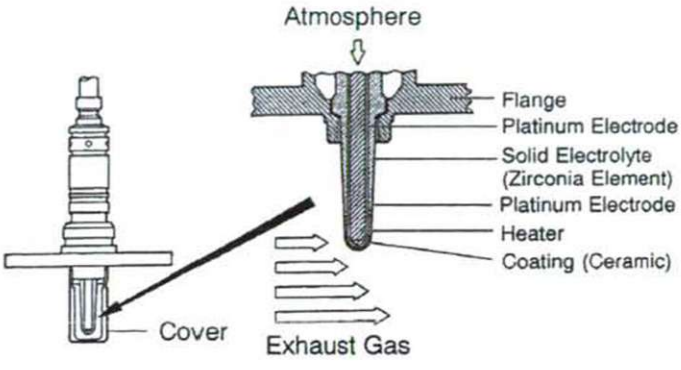


Figure 6. Oxygen sensor

When the system is operating correctly the oxygen sensor OX1 (before catalytic converter) output varies between approximately 0,1 V and 0,9 V, and the frequency of change for the sensor signal is around 1-3 Hz.

If catalytic converter is working, it consumes oxygen. So after catalytic converter, the oxygen sensor OX2 must generate voltage about 0,6…0,8 V (see Figure7).

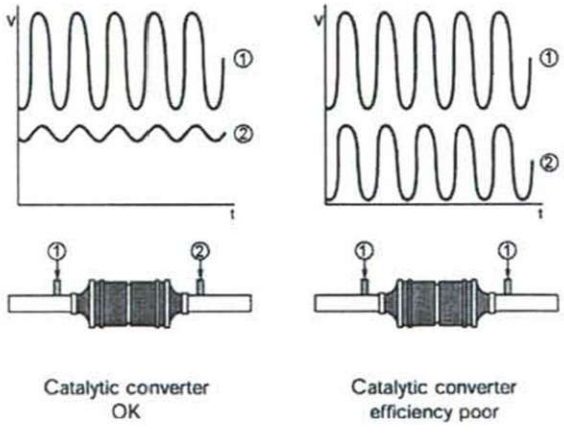


Figure 7. The voltage traces from the upstream and downstream oxygen sensors

4. SIGNAL MEASUREMENT PROCEDURE

Connect the first inlet canal of data acquisition device "E-Biol" to oxygen sensor contact OX1 (positive) and E2 (earth) (Figure 8). Connect the second inlet canal of data acquisition device "E-Biol" to oxygen sensor contact OX2 (positive) and E2 (earth).

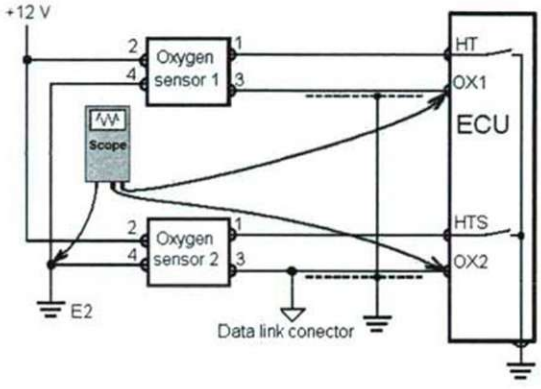


Figure 8. Engine (2NZ-FE) oxygen sensors OX1 and OX2 connection diagram

Start up engine simulator. The throttle valve must bee partly open. Engine rate: 2000...2500 rpm (revolutions per minute). Electric signals from oxygen sensors OX1 and OX2 are transmitting in engine ECU (Figures 9; 10; 11). Record signals from oxygen sensors OX1 and OX2.

Figure 9 shows the diagram of the voltage signal that derivable at the output of oxygen sensor 1 and oxygen sensor 2 when oxygen sensors and three-way catalytic converter are cold.

Figure 10 shows the diagram of the voltage signal that derivable at the output of oxygen sensor 1 and oxygen sensor 2 when oxygen sensors are hot but three-way catalytic converter is warm.

Figure 11 shows the diagram of the voltage signal that derivable at the output of oxygen sensor 1 and oxygen sensor 2 when oxygen sensors and three-way catalytic converter are hot.

This pattern shows the oxygen sensors control's signal when the engine winding is medium.

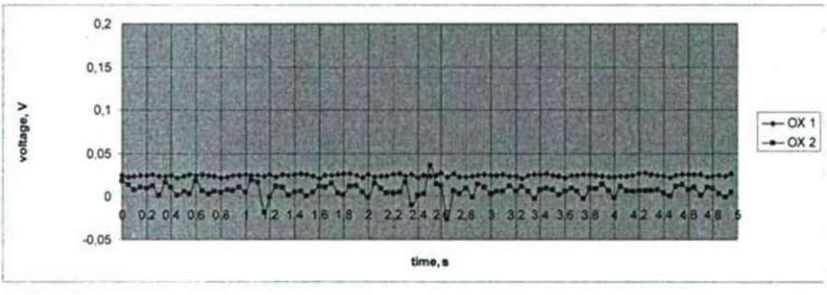


Figure 9. Signals from heated oxygen sensor 1 and oxygen sensor 2 (oxygen sensors and three-way catalytic converter are cold and does not function). a – OX1 signal; b – OX2 signal

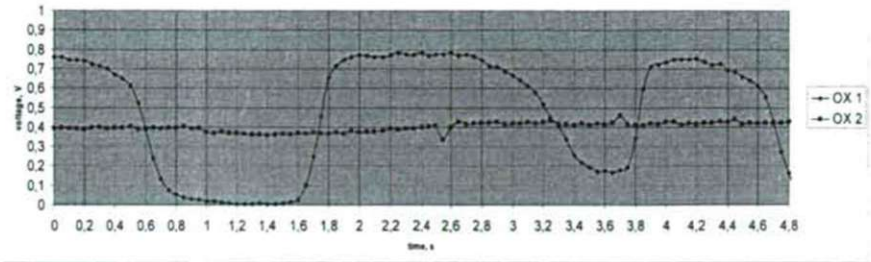


Figure 10. Signals from heated oxygen sensor 1 and oxygen sensor 2 (oxygen sensors and three-way catalytic converter are warm and functions partly). a – OX1 signal; b – OX2 signal

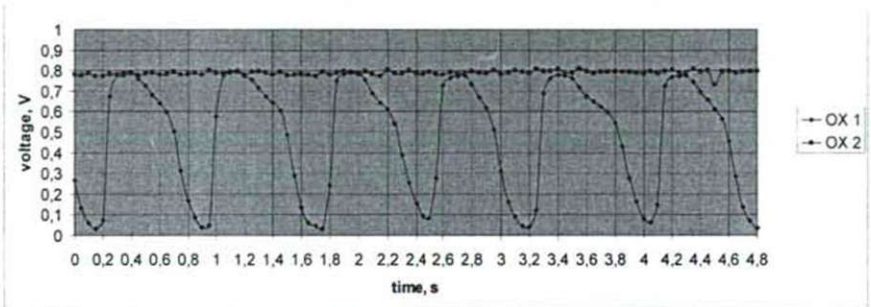


Figure 11. Signals from heated oxygen sensor 1 and oxygen sensor 2 (oxygen sensors and three-way catalytic converter are hot and functions). a – OX1 signal; b – OX2 signal

Exhaust gas composition measured with gas analyzer. When the catalytic converter reaches 300 °C, the engine exhaust emission control starts and their toxicity does not exceed the permitted levels.

4. CONCLUSIONS

1. Oxygen sensor starts to function reliably when the temperature reaches approximately 300...350°C. An ideal temperature for operate is around 600°...800°C.
2. The electrical signal's diagram from oxygen sensors OX1 are stand within the pale 0,1...0,9 V.
3. The frequency of change for the sensor signal is around 1...3 Hz, depending on an engine's speed, a temperature and other factors.
4. The action of a catalytic converter, OX2 has generated voltage about 0,6...0,8 V.
5. The action of oxygen sensor and catalytic converter, exhaust gas toxicity is minimal.
6. The investigation of signals used for car engines electronic control is an effective way to improve understanding materials of the "Automobile electronic control systems" course.

LITERATURE

1. Hillier V. A. W., Coombes P, Rogers D. (2006): Fundamentals of motor vehicle technology. Powertrain electronics, London, "Nelson Thornes".
2. Bosch Robert (2004): Gasoline-engine management, Cambridge, "Bentley publishers".
3. Bosch Robert (2004): Automotive electrics. Automotive electronics, Cambridge, "Bentley publishers".
4. Bosch Robert (2000): Автомобильный справочник, Москва, "За рулем", (in Russian).
5. Rimkus A., Kaikaris P., Snipaitis M. (2007): Automobiliu diagnostika ir technine prieziura, Kaunas, "Arx Baltica", (in Lithuanian).
6. Berger K.J., Braunheim M., Brenncke E., Ehlers H. C. (2003): Technologie kraftfahrzugtechnik, Troisdorf, „Bildungsverlag", (in German).
7. http://e-prolab.com/comlab
8. http://techdoc.toyota-europe.com
9. http://kfz-tech.de/Lambdasonde.htm

SYNERGIC DISORDERS IN THE EARLY OPERATION OF THE SZEGED REGIONAL WASTE MANAGEMENT PROGRAM ISPA PROJECT

Ferenc Szabó
University of Szeged, Faculty of Engineering

SUMMARY

On the basis of a case study I present the experiences of the operation and the typical operational conflicts of the completed Hungarian EU environmental infrastructure development projects, first of all concerning the cooperation of the beneficiary local governments. In the analyzed case – "Szeged Regional Waste Management Program" ISPA project – the legal beneficiary is the municipality of Szeged, but the other 32 municipalities of the region are also interested in the successful implementation of the project and are responsible for the continuous long run operation.

1. INTRODUCTION

The investment operations of the Cohesion Fund (former ISPA project), entitled „Szeged Regional Waste Management Program" have been completed. After the trial operations and pilot running, technological handing and taking over was done and operation started. I will overview the operational observations and the conflicts marking this operation – via the analysis of this project – in investments that have been realized as part of our country's share of the European Union's projects to develop the infrastructure of the protection of environment. My concern is focusing on the recipient local governments' network. The legal beneficiary is the municipality of Szeged, but the other 32 municipalities of the region are also interested in the successful implementation of the project and are responsible for the continuous long run operation.
After project planning, the public procurement procedure and contracting effective implementation begins that involves concentrated outsourcing and utilization where planning (implementation plans and plans marking the stages so far realized), construction, assemblage and pilot running are performed according to professional criteria defined by technological-economic rules. This stage within the process of the realization of the facility immediately provides the manufacturing or supplying facility itself effectively completed, ready to operate or to be made use of (Görög, 2001). The discipline of project management emphasizes the importance of assessing and analyzing the observations collected which is an significant part of follow-up control. The synergic disorders and conflicts among governments properly characterize the idiosyncratic status of the protection of environment, and, within this issue, that of waste management.

2. ASSESSMENT

Ideas, conditions and aspects of how to operate the project have undergone a significant change in comparison with the preparation phase. Especially conditions of operation have

been altered due to the modification of the rules of procurement and the passing of the Procurement Act.

2.1. Selection of the agency for commission to operate project facilities

The Municipality of Szeged as managing contractor of the consortium for waste management formed by 33 localities of the region – the "beneficiary" of the project – is in sole possession of the municipal property that had come into existence via the realization of the project. According to the Procurement Act there ought to be a public call for tenders so as to select a public servant agency fit for the long-term operation of facilities. Development was originally aiming at the setting up of an integrated regional system of waste management and the project's prompts of developing waste management constitute only some of this system's targets. Incorporating a supplier that is sufficient in terms of the Law but "systematically incompatible" (primarily business-oriented agency) would cause serious misrule and, supposedly, significant extra expenses. Core services, local public services managing waste (the collection of local solid waste, its transport, disposal, salvage) are closely connected to the operation of the system realized within the ISPA project it is, actually, not part of the project. This causes problems during operation because public services and, at the same time, the regional system of waste management are financed from the receipts of local public.
If the ISPA implementations' operation is running completely independent of the operation of basic public services, besides questions of perpetual financing on a sufficient level, there may, inevitably, arise problems of a professional nature, since there will arise conflicts and clashes of interests among agencies of public services and the agencies operating Union development implementations. This is the reason why the municipality of Szeged has decided that with reference to one of the exceptions secured by the Public Procurement Act, it appoints – without a procurement procedure – one of the non-profit Szeged-located waste management corporations with limited liability, owned in 100% by the local government, to operate ISPA development implementations. The non-profit ltd. (hence appointed operator) was acting throughout the period of preparation and realization as deputy project manager and was coordinating and directing on behalf of the municipality.

2.2. The Unilateral Financing of the Project (coded conflicts and tensions)

In case of Szeged between 2000 and 2008 every year there has been a 10% raise in the waste disposal fee over the annual inflation which has resulted in the doubling of the real value index of the fee paid for the disposal of local waste disposal public services. This extra income provided for the availability of the municipal potential that was necessary during the investment period (and which Szeged had volunteered to provide for solely by itself), and, in time of operation it has been providing for the extra expenses needed for the provision of a higher level service. Other localities within the region have not raised service fee and, consequently, now there are significant differences among localities near to one another.
Since public service agency property has come, formally, into Szeged's possession, the provision of one's own resources was reasonable. But there are no reasons on account of which the situation in which inhabitants of localities situated in a distance of 10-15 km would have to pay 50-70% more or less for the same service (oddly enough, those who live farther pay less) should stay unchanged. To put it in a nutshell, the realization of the

project has resulted in a situation in which the inhabitants of Szeged pay the extra expenses of a higher level public service instead of the inhabitants of neighboring localities.

2.3. The Root of Tensions

The situation at the moment is complex, and tension has been originating in a number of factors the primary font of all of which is the fact that no standard waste managing region has been formed yet. Basic services are operated by a number of local public contractors who used to provide services varying both in aspect and in content, the consequence of which is the incoherent system of service fees at present.

2.3.1. Public Service in Szeged

The public service contractor in Szeged is the non-profit ltd. It has been collecting the higher fee set by the municipality of Szeged both in Szeged and in the localities annexed. The funding of the project has been reserved from this amount. This resource of its own has been transferred to the municipal budget formally as rental fee which has provided for immediate financing.

2.3.2. Regional Activity Provided by the Szeged Public Service Contractor

The non-profit ltd. has been operating public service of the same nature for other localities. It has won these contracts in public procurement procedures so, consequently, the fee applied in these cases is considerably lower than the fee applied in Szeged. (No public procurement procedures could be won with these higher fees.)

2.3.3. Setting up a Consortium for Waste Management

The majority ownership of a competing agency involved (partly owned by other counties' municipalities) was bought out in 2006 and the non-profit ltd. made a major step towards the realization of a standard regional waste management system since it had been able to match professional criteria and the actual technology of the services. This, however, has not in itself dissolved the tension arising from the difference of fees – on the contrary: it has increased it, now, within the consortium. The consortium have decided that within 5 years they try, in close collaboration with the municipalities involved to draw up a system of standard fees, a sort of fee consortium within which the level of fees differs at the maximum of 10% from one another. (In the last two years there has been significant leveling in this field in comparison with the former situation.)

2.3.4. Other Public Service Contractors in the Region

There is a third private party in the service in the region whose presence causes difficulties. Municipalities involved have been attached to their contractors most probably under the mistaken view that low fees have been due to this agencies. While, in fact, it is the low quality of their service and its poor content that has allowed the contractor to provide service at a lower rate. The completion of the ISPA project and the launching of operation have given rise to a new situation from every point of view. From now on no lower level

public service is going to be allowed to operate. This means that the local contractor for public service has to provide a standardized operation with an identical content, irrespective of the legal person who is in possession of the agency. They must make use of the regional waste depots with posterior technologic protection (The recultivation of former waste depots located in villages has not yet started – they, anyway, have been closed for years.), and they also must run collecting waste-heap embankments and waste depot courts for selective waste collection. This results in a significant rise of extra expenses because within the tariff construction of waste management collecting and transporting waste cost 30% of the overall expenses at the most. More than two thirds of the cost of waste management operation is spent on depositing waste in safe sealed depots that match EU standards and on selective waste collection and on other waste processing facilities (collection plant, composting, construction waste processor, etc.). In localities where they have solely had to pay for transporting waste, rates may become 2-3 times higher.

2.4. Financing Extra Operational Expenses Related to the Development of Waste Management

The best way to build in significant extra expenses arising from operation – mostly from the orderly disposal of waste at a sealed depot and from selective waste collection (waste collecting islands and waste depot courts) – a constituent of the local public service's rate construction since these forms of waste processing are the organic parts of the local waste management public service.

2.4.1. Invoicing Extra Expenses with Public Service Contractors Related to Municipalities

The two contractors possessed in immediate and collateral majority by the municipality of Szeged – with the consent of local governments involved – are step by step building in extra expenses with the rate construction of public services as part of their mid-term strategy and tariff politics. So these fees are on their way to get leveled with the fees paid in Szeged which had been raised formerly.

2.4.2. Invoicing Extra Expenses with Public Service Private Contractors

In case of private contractors a principle has been agreed upon, according to which municipalities and the specified contractor negotiate every year the rate of extra expenses to be expected which, accounted via posterior invoicing, is to be checked and is corrected in view of the effective expenses. The rate that has been agreed on will be built in the construction of the public fee by the local contractor operating the service locally and is reimbursing it to the specified public agency in the form of waste disposal rates specified for each agency respectively.

These have been, however, strong arguments concerning the extra expenses to be expected during the realization of the protocol. Calculations by the specified public agency have not been verified by the municipalities involved, and, consequently, the process partly has come to a halt.

a) Contesting Amortization

Municipalities first questioned the amortization of waste plants located in the localities and the level of amortization marked. They have found the expenses of realization and the invoiced rates disproportionately high. Implementation was realized within the frame of a regular public procurement procedure, and, consequently, invoiced rates cannot be contested retrospectively. Invoiced rates are, generally, set by the currently valid financial and accountancy rules. (In second checking the use of supports, the EU monitors especially amortization politics applied by beneficiaries in case of facilities realized as part of the developments. They consider it, for obvious reasons, the outstanding condition of long-term operation.) With the help of KvVM Development Headquarters municipalities have been persuaded to accept that the invoicing of expenses of amortization is inevitable.

b) Contesting Operational Expenses to be Expected and Choices of Expense Reduction

After this the arguments were focusing on operation expenses to be expected. Municipalities have not accepted the prospective calculations of transport expenses, reasonable opening hours and the expenses of maintenance needed. They have offered to do the maintenance on their own free of charge. Staff of the waste plant would be provided for in the form of social service and the transportation of waste disposed on the premises of the waste plant will also be organized by them free of charge with the help of local contractors. The appointed contractor has noted that primarily on account of regulations concerning public procurement, the suggestion concerning how to operate waste plants can only be realized partially – their legal conditions have to be checked before. In principle they are not against any form of reducing expenses but in each case contracts must settle what the parties may do and what they must. Furthermore, they insist that the expenses of the waste court which has been made use of solely by the inhabitants of the locality concerned should be paid for via charging the exact effective expenses at least afterwards.

2.4.3. Compromises to Let Operation Begin as Soon as Possible

In the end, again via the mediation by the KvVM Development Headquarters an agreement was made according to which expenses for 2009 will be constructed at a rate which is considerably lower than the real price, the posterior correction of which may become viable only in 2010. This means that the majority of effective extra expenses will still be paid in advance instead of some neighboring localities in 2009 by the inhabitants of Szeged.

The municipality of Szeged and the appointed agency for public services have had to make do with these disadvantageous compromises because they have to settle every question of disagreement not yet solved by the time of completing the project – by the 30th of June, 2009 – and facility, staff and finance will have to have been secured at a level sufficient enough for permanent operation, the legal status and ownership of the property will have to have been clarified and all the contracts needed will have had to be made: they will all in all secure that the project will have been fully realized and will be working permanently.

Waste courts were technologically put into operation in the first half of 2008 and in the contested cases – in lack of agreement – permanent operation has not yet started. This fact in case of a possible control by the union will have serious consequences.

3. SUMMARY, CONCLUSION

I have examined the operational observances from the perspective of the beneficiary municipalities' cooperation of facilities realized, accessories purchased within the frame of the ISPA/Cohesion Fund program, entitled "Szeged Regional Waste Management Program" after the analysis of the observances of planning, preparation, public procurement procedure and the realization of the particular tenders. Conflicts between the appointed service contractor and the municipalities have been arising primarily when securing the operative conditions of facilities, realized on the premises of the particular municipalities that had joined the project, used by the inhabitants of localities involved immediately. Higher level public service, including the selective collection of waste (running waste courts and waste collecting island heap embankments) costs considerable extra money which is to be paid, by all means, by the inhabitants who make use of the compulsory waste disposal public service. The majority of municipalities are facing the fact that has been obvious for years and could have been expected to come to the surface: feès paid by the inhabitants must be raised significantly. Szeged municipality has raised the fee of this public service in real value to the double of its original during the last 7-8 years – since Szeged has had to finance its own resources for the development in advance – while, at the same time, the rest of the municipalities have raised rates at the maximum level of inflation. (The public property hence gained, quid pro quo, has come into the possession of Szeged.)

But it is not tenable any more that inhabitants in localities situated in one another's vicinity pay for a service of considerably identical quality and content disproportionately different fees. The inhabitants of Szeged have had to volunteer the overall burden of preparation and implementation. The project is running and there are no reasons on account of which the inhabitants of Szeged should pay any expenses invoiced for waste management done in other localities. The different fees are causing significant discontents among the particular municipalities and among the inhabitants of the particular localities. Leveling rates is inevitable, which will be giving rise to further novel discontents and conflicts. Szeged is a good example of how considerate well-timed, calculable mid-term rate politics – sensitive to the inhabitants' potential of endurance – may reduce tension and conflicts; and even the conditions for a nationwide megaproject may be provided for.

The analysis and assessment of the operational observations of environment protection infrastructure development projects sponsored by the support given to our country by the European Union may significantly promote the realization of projects financed by structural funds.

BIBLIOGRAPHY

1. Görög Mihály (2001): Bevezetés a projektmenedzsmentbe, Aula Kiadó, Budapest.
"Szeged Regional Waste Management Program" documentation

PHYSICO-MECHANICAL INVESTIGATIONS ON DIFFERENT WINTER WHEAT VARIETIES

Balázs P. Szabó, András Fekete, Antal Véha, Ernő Gyimes
University of Szeged, Faculty of Engineering

SUMMARY

The kernel hardness is a significant characteristic. Wheat kernel hardness determines quality, flour yield, flour particle-size, water absorption and other quality characteristics of cereals. The final classification for wheat is kernel hardness.
The aim of our research was to determine the kernel hardness with new static methods. To the static methods we used the Lloyd 1000 R Testing Machines. We determined the kernel hardness with the well-known and recognized method also. It was the Perten Single Kernel Characterization System (SKCS) 4100 device.
Registered and widely used Hungarian wheat varieties were applied in the study. It was 11 different winter wheat varieties (7 of HRWW and 4 of SRWW). The samples were labelled with code number. Our aim was to compare these methods.

1. INTRODUCTION

Kernel hardness is an important measurable attribute of wheat that has been correlated to it's chemical and genetic make-up. The evaluation of wheat kernel hardness has been used in predictions of flour yield and gives early indication of baking performance (Pomeranz and Williams, 1990). Factors influencing kernel hardness include variety and environment, however the total variation in hardness has yet to be explained.
Kernel hardness controlls by friabilin protein and it depends on the relation between protein matrix and starch granules. The friabilin presents in high concentration in soft grain varieties and low concentration in hard grain varieties. The flour which is made from hard winter wheat varieties are better than the flour which is made from soft winter wheat varieties. Such indicators are flour yield and flour particle size since the adhesion between the starch granules and proteins of hard varieties is so strong in the milling process that starch granules fragment rather than get released from the protein matrix as they do in soft wheat varieties. This will have the greatest effect on the resulting flour's baking properties. Hard wheat flours have a medium to high protein content and stronger gluten-forming proteins than soft wheat. Consequently, hard wheat flours tend to be ideally suited for yeast-raised products that depend on gluten strength to retain leavening gasses. Soft wheat flours are lower in protein and gluten strength and are more commonly found in pastries and chemically leavened products (Evers et al. 2002).

2. MATERIALS AND METHODS

The aim of this research was the investigation of winter wheat varieties. We investigated the kernel hardness in wheat varieties widely used in the Hungarian agriculture.

Materials

11 entries (registered wheat varieties) of bread with diverse technological qualities were used in this study (7 of HRWW and 4 of SRWW). The entries produced in the year of 2006 in Szeged, Hungary and were evaluated for various quality characteristics.

Methods

The Perten SKCS 4100 instrument is one of the well know machines, which examine the kernel hardness. This device measures kernel texture by crushing the kernels one at a time, recording the force required to crush the kernel, and reporting the average force for crushing 300 kernels, in terms of a hardness index (HI) (Martin et al. 1993)

Figure 1. Perten SKCS 4100 instrument

We determined the maximum breaking force, the break work, the deformation modulus with the LLOYD 1000 R Material Testing Machines. We examined the grain in vertical position. To the vertical position: we scraped the grain, the surface on the side of the beard and the germ and this machine presses the kernels with the compressor head of Lloyd 1000 R testing machine of 1000 N force, and by reading the force – displacement curve. From this graph we read the breaking force, and calculate the deformation modulus and the break work. This method is a new invention (Szabó et al 2006).

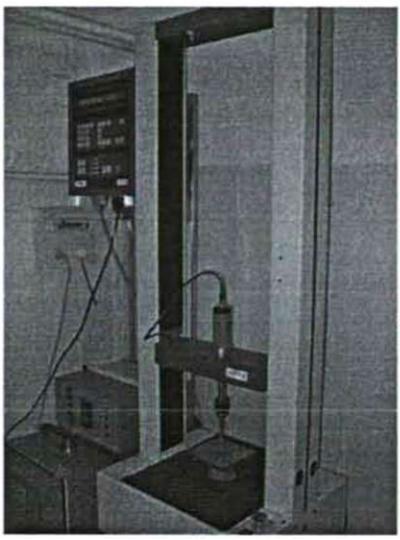


Figure 2. Lloyd 1000 R testing machines

3. RESULTS

The deformation modulus (E), the breaking force (F_t) and the break work (W_t) were determined by the penetrometer (Lloyd Instrument). The Hardness Index was determined by SKCS device.
In our previous research we examined the samples with different moisture content. Our hypothesis was that the moisture content is a very important behavior of the samples. Now, the moisture content of the entries were 13,52 %. It is a good moisture parameter to the safety storage.
Average of 30 kernel of the deformation modulus, breaking force, break work show one point in the diagram.
Figure 3 shows the connection between the deformation modulus and Hardness Index.

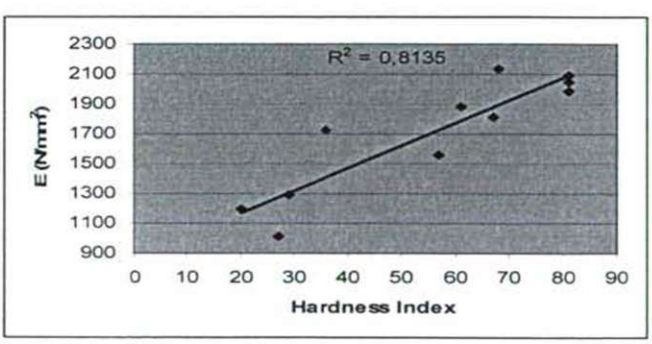


Figure 3. Connection between the deformation modulus and Hardness Index

The equation:

$$E = 15{,}038 * HI + 871{,}91 \ (\mathbf{R^2=0{,}813})$$

E: Deformation modulus (N/mm^2)
HI: Hardness Index

Figure 4 shows the breaking force and Hardness Index connection.

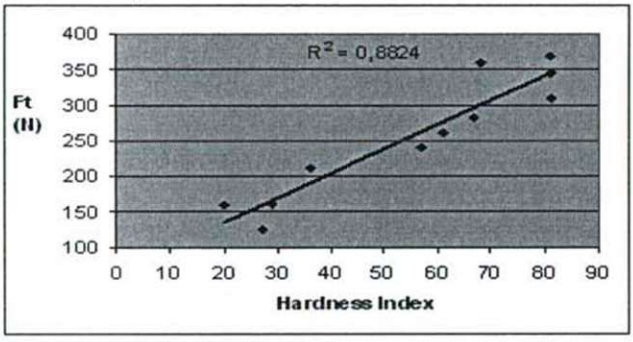


Figure 4. Breaking force and Hardness Index connection

The connection between the breaking force and the Hardness Index is strong. The equation:

$$\text{Breaking force} = 3{,}4192 * HI + 67{,}272 \ (\mathbf{R^2=0{,}882})$$

HI: Hardness Index

Figure 5 shows the break work and Hardness Index connection.

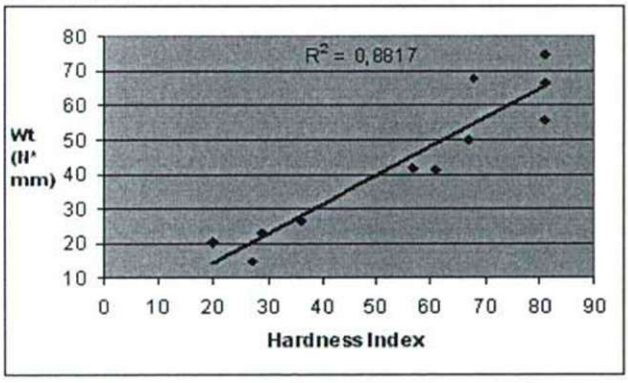


Figure 5. Break work and Hardness Index connection

There is a strong correlation between the break work and the Hardness Index:

$$\text{Break work} = 0{,}8403 * HI - 2{,}5049 \ (\mathbf{R^2=0{,}882})$$

HI: Hardness Index

The average of the deformation modulus was: 1304,77 N/mm^2 – soft wheat varieties;1930,76 N/mm^2– hard wheat varieties. The average of the breaking force was:

164,34 N – soft wheat varieties; 308,78 N – hard wheat varieties. The break work: the average was 21,34 N/mm – soft wheat varieties; 56,85 N/mm – hard wheat varieties.
We found strong correlation between the Hardness Index and the mechanical properties (deformation modulus, breaking force, break work), when the moisture content was 13,5%.

REFERENCES

1. Balázs P. Szabó - Ernő Gyimes - Antal VÉHA (2006): Static method for measuring wheat kernel hardness, Within the European Union III. International Conference Mosonmagyaróvár, 6-7 April 2006. ISBN 963 9364 67 3.
2. Evers, T. – Millar, S. (2002): Cereal grain structure and development: Some implications for quality. Journal of Cereal Science, Vol. 36.., No. 3,261-284. p.
3. Gyimes, E. – Neményi, M. – Véha, A (2002): Reológia és szemkeménység összefüggése őszi búzáknál In: Ötven éves az Acta Agronomica Hungarica Martonvásár, p. 117-124.
4. Martin, C. – Rousser, R. – Brabec, D. (1993): Rapid, single kernel grain characterization system, U.S. Patent No. 5,005,774.
5. Pomeranz Y - Williams Pc (1990): Wheat hardness: its genetic, structural and biochemical background, measurements and significance. In: Advances in Cereal Science and Technology, AACC, St. Paul, vol. X: 471-544.

CONSUMERS' PREFERENCES AND ATTITUDES ON THE MARKET OF THE TRADITIONAL HUNGARIAN FOODS

Orsolya Szigeti[a], Viktória Szente[a], Zsolt Polereczki[a], Bernadett Kovács[b], Gedeon Totth[c], Zoltán Szakály[a]

a. Kaposvár University Faculty of Economic Science, Department of Marketing and Trade, H-7400, Kaposvár, Guba Sándor str. 40

b Kaposvár University Faculty of Economic Science, Department of Accounting and Statisics, H-7400, Kaposvár, Guba Sándor str. 40

c. Centre for Agricultural Marketing, H-1042, Budapest, Árpád str. 51-53

ABSTRACT

An overall quantitative market research was carried out to reveal the consumers' behaviour relating to traditional Hungarian foods. This research aimed to get information on the consumption and buying habits of Hungarian consumers as well as the preferences and attitudes connected to these products.

The research was based on a 1000 questionnaires inquiry that was representative and random. The sample mirrors the population in five factors: region, type of settlement, sex, age and educational level.

Data were analyzed by using frequency distribution, means and cross-tables. Chi-square test was used in case of percentage distribution to define the level of significance and ANOVA in case of multivariate statistical analysis.

The research revealed that the category of traditional Hungarian food is more obvious for the consumers than hungaricum is. According to the results, the most known hungaricums are Pick salami, Szegedi paprika, Gyulai sausage and Makó onion. It was found that hungaricums are part of daily nutrition of most of the people. In their shopping decisions the consumers regard flavour as the most important factor; which indicates the primary importance of enjoyment value of this type of food above any other factors. Concerning quality issues, the consumers' expectations towars food security aspects, such as the freshness of the product and legal requirements were listed as most important factors. The results show that this group of products enjoys a kind of status of trust, which is reasonable to exploit in communication messages. Six different consumer groups were determined with factor and cluster analysis by using life style variables.

Research Work

1. INTRODUCTION

The theme of the research is actual, because after the EU-accession of Hungary, the producers of agricultural products faced hard market circumstances, *strong competition of the concurrences and importer companies*. A possible development strategy is to strengthen the position of the segments belonging to the competitive sphere. Another opportunity is given by such sectors that do not belong directly to the competitive sphere, and *bear specific, significant tradition in the Hungarian history*, which are targets of the developments within environmental and landscape management, tourism, employment, rural areas and income supplement measures, as well. Sustaining or improving market shares is possible with recognising and strengthening the values of native, traditional and county specific animal and plant species and products (hungaricums) (KOVÁCS et al, 2003).

The word hungaricum is used by many and in several aspects, although it has not been exactly defined. It is used in relation with not only food, but all of those products that are in relationship with Hungary or Hungarian traditions. Even a "threshold limit" has not been determined, any producers can decide on referring their products to as hungaricum. Contrary, traditional Hungarian food is "any animals or plants or food products of these origin that is connected to Hungarian producing culture, knowledge or tradition formed by the generations of Hungarian people and which is acknowledged by the Hungarian population or at least by the population of a region as Hungarian product, as being typical for Hungarians and well-known, and also it is internationally accepted as Hungarian speciality" (ANDRÁSFALVY, 2003).

Based on the earlier studies on traditional Hungarian foods (POPOVICS and GYENGE, 2006; NÓTÁRI, 2008), the aim of the survey was to get detailed information on the Hungarian consumers' consuming and purchasing habits and their preferences and attitudes related to traditional products.

2. MATERIAL AND METHODS

Countrywide, altogether 1000 personal interviews were done at the homes of the interviewed people. The sampling was based on the *random walking* technique, which ensures the stochastic theory in the selection of the interviewed people. The so called *birthday key* was used to choose the person for the interview. In order to ensure representativeness, the sample was corrected by multidimensional weighing (gender, age, qualification), thus the sample is representative for the basic population according to five dimensions (region, type of settlement, gender, age, qualification).

The *majority* of the questions were *closed ones*, but in order to get information on the opinion of the people *several open questions*.

Data processing and displaying the results were based on SPSS version 13.0. The tables show the *relative frequencies* of the whole population. In case of *scale-type questions* (mostly the grades varied from 1 to 5, where 1 means the poorest 5 the best value; in one case from -2 to +2 representing the direction of influence) mean scores and ratios were calculated. In case of other questions, the dates were presented in *cross-tables* and expressed in ratios, where *Chi-square test* was used to test the difference and to define the level of significance. The multivariable statistical analysis was based on *ANOVA*. *Factor and cluster analysis* of the living variables were used to define the six segments of the population.

3. RESULTS AND DISCUSSION

3.1. Reputation of the definitions hungaricum and traditional Hungarian food

The first block of the questionnaire analysed the interpretation of the definitions *traditional Hungarian food* and the similarly used *hungaricum by consumers*. Within this, first the spontaneous reputation of these definitions was surveyed. The first four questions were also filtering questions, because if somebody did not understand the expression of traditional Hungarian food or hungaricum, was not asked to continuo the interview.

The great majority (85.2%) of the interviewed people has heard about hungaricums; it was un-known by only 14.8 per cent of them. The definiteness of the opinions is reflected by the fact that none of them gave an answer "does not know or does not answer".

The next question analysed *the associations of the interviewees in relation with hungaricum*, what stereotypes or ideas the consumers have in their mind.

The ideas on the definition of hungaricum were similar; it means something that is Hungarian, it means a product that is in connection with Hungary and the Hungarian traditions. It was however also obvious that the people have not got more exact definitions. This is also proved by that most of the interviewees could not point out further categories beyond the one "something Hungarian" listed at first place (82.6%), while a third category was given by only 16 (1.6%) people. The high number of foods mentioned in this group reflects on that the image of hungaricum is closer to foodstuff. Some one fifth (18.7%) of the interviewees could not give any answer on the definition; this means that many people do not understand the definition, despite of hearing about it.

Next question asked on the awareness of the expression traditional Hungarian food. Almost 95 per cent of the interviewees have information on the expression, which is almost 10 per cent higher than in case of hungaricum. The differentiation of these definitions can be useful in the communication strategy.

The category of traditional Hungarian food is more obvious for the consumers than hungaricum is. The number of those that could not define it was only half (9.8%) of that of hungaricums. However, much more of them gave two positive answers. Those aspects were listed at first place that reflect on Hungarian origin, traditional production and generation-old recipes. These were followed by the expectations towards Hungarian raw materials; and at the end stereotypes in connection with Hungary (paprika, goulash) and demand for locality were listed.

Then, *names of well-known traditional Hungarian food products were asked.* The first third of the answers gave such names as Pick salami, Szegedi paprika, Gyulai sausage or Makó onion. Only one general product was listed (paprika), although both typical types (Szeged, Kalocsa) of it were given here as well. These were more frequently followed by more general product names, such as wines, sausage and palinka. In the category of other products, such products were listed that have local importance but are not known countrywide.

3.2. Consumption and purchase of traditional Hungarian foods

Majority of the interviewed (96.6%) usually consumes traditional Hungarian foods. This means that these sorts of products are part of daily nutrition of most of the people. Almost all of those who do not consume Hungarian food products indicated the higher price as the reason. However, they represent only 3.1% of the population.

The consumption *frequencies of traditional foods* are shown in **Table 1.**

It is seen that those who consume these products do it quite frequently. 58.1 per cent of them have such food 2 to 3 times per week. If we also consider those with weekly frequency, the share of these two groups is 76.1 per cent.

Table 1. Frequency of consumption by categories of product-consumptions (N=966)

Frequency category	Number and percentage of answers	
	head	%
Daily	302	31.3
2-3 times per week	259	26.8
Weekly	173	17.9
2-3 times per month	136	14.1
Monthly	50	5.2
Rarely than monthly	46	4.8

Table 2 summarises the results of the given answers on the questions *on buying places of traditional Hungarian foods*. (The interviewed might give more than one answers.)

Table 2. Buying places of traditional Hungarian foods according to their consumers (N=966)

Nomination	Number and percentage of answers	
	head	%
Smaller food shops	440	45.7
Hypermarket	417	43.3
Supermarket	408	42.4
Directly from producer	145	15.1
Discount store	138	14.3
Own produced by family	61	6.3
Other	33	3.4
Does not buy	9	0.9

The highest frequency is seen in case of smaller shops as buying place. It was closely followed by hypermarkets and supermarkets. Smaller part of the consumers buys these products directly from producers or from discount stores. In the category of other places, buying on markets was mentioned with only one exception.

It was also found that more than half of the interviewed people are *willing to pay higher price for traditional Hungarian food products*, although the ratio of those who will not pay more is high (41.0%).

Those who are willing to pay higher price for traditional products than that of mass products *were asked about the percentage of this extra price in case of 10 different product groups*. The results are shown by **Table 3** and **Table 4**.

The majority of the consumers is willing to pay maximum 10% extra price for the traditional Hungarian products. Relatively small is the ration of those who would pay more. Most of them are willing to pay 10% more for mineral waters and bakery products, least of them for wines and liquor.

Table 3. Acceptable additional price in case of different product groups (N=548)

Product group	Willingness for paying extra price, %													
	<10		<20		<30		<40		<50		>50		Not know/ans	
	head	%	head	%	head	%	head	%	head	%	head	%	head	%
Milk products	357	65.1	132	24.1	32	5.8	4	0.7	4	0.7	1	0.2	18	3.3
Meat products	300	54.7	161	29.4	46	8.4	12	2.2	8	1.5	6	1.1	15	2.7
Fruit and vegetable	322	58.8	139	25.4	48	8.8	8	1.5	9	1.6	3	0.5	19	3.5
Mineral water	381	69.5	83	15.1	26	4.7	4	0.7	3	0.5	2	0.4	49	8.9
Wine	283	51.6	106	19.3	66	12.0	13	2.4	11	2.0	7	1.3	62	11.3
Liquors	283	51.6	108	19.7	48	8.8	13	2.4	10	1.8	4	0.7	82	15.0
Spices	306	55.8	140	25.5	58	10.6	6	1.1	12	2.2	4	0.7	22	4.0
Preserved fruit and jam	328	59.9	115	21.0	46	8.4	6	1.1	9	1.6	3	0.5	41	7.5
Sweets	349	63.7	98	17.9	41	7.5	8	1.5	8	1.5	2	0.4	42	7.7
Bakery products	373	68.1	105	19.2	26	4.7	5	0.9	8	1.5	5	0.9	26	4.7

If the percentage figures of the extra price is marked with rank numbers (<10% = 1 ... >50% = 6), the order is different **(Table 4)**.

Table 4. Main statistical descriptives of extra price dates

Product group	n	Mean	Deviation	Mode
Wine	486	1.73	1.09	1
Meat products	533	1.66	0.97	1
Liquor	466	1.65	1.02	1
Spices	526	1.65	0.97	1
Fruit and vegetable	529	1.59	0.91	1
Preserved fruit and jam	507	1.54	0.91	1
Sweets	506	1.49	0.88	1
Bakery products	522	1.44	0.88	1
Milk products	530	1.43	0.74	1
Mineral water	499	1.34	0.73	1

In this case, people would pay the highest extra price for wines and the lowest for mineral waters. With other words, typically, people would pay only 10% more for bakery products, milk products and mineral water, while for alcoholic drinks, people would pay even higher extra price.

In the following, the role of *18 different influencing factors was analysed on the buying decisions in case of commerce products and traditional Hungarian products*. The results of the analysis on traditional foods are shown in **Table 5**. The factors were given marks from -2 to +2.

Table 5. Main statistics of factors influencing the purchase of traditional Hungarian foods

Influencing factor	N	Mean	Deviation	Mode
Flavour of the product	965	1.68	0.58	2
Stable quality of the product	965	1.65	0.66	2
Likes all family	960	1.55	0.68	2
Quality trademark	966	1.53	0.73	2
Hungarian producer in Hungary	963	1.49	0.77	2
Trademark on traditional production	965	1.41	0.77	2
Aesthetics and appearance of the product	965	1.39	0.75	2
Brand-name	965	1.36	0.81	2
Health promoting effect of the product	964	1.27	0.84	2
Name of the producing company	965	1.22	0.86	2
Habits	962	1.22	0.85	2
Practical, easy-to-handle packaging	966	1.11	0.86	2
Indicating the region of origin	959	1.10	0.92	2
Price of the product	964	1.06	1.17	2
Available anywhere	961	1.00	0.94	2
Advertisement of the product	956	0.41	0.94	0
International producer in Hungary	956	-0.41	1.23	0
Import product	958	-0.75	1.22	-2

In comparison with ordinary foods, the most important factor was the flavour (as opposite with quality and family preferences); which indicates the primary importance of enjoyment value above any other factors. These are followed by such factors coming from the traditionalism of these products, as quality warranty, Hungarian producer, labelling proving traditional production. Healthiness of the product takes the same position (9^{th} place) as that of the ordinary foods, however with much more positive influence (1.27 vs. 1.02). Indicating the place of origin is a less important factor (13^{th} place), although with almost twice as high figure than in case of food produced industrially (1.10 vs. 0.69). Similarly to ordinary foods, two factors were indicated with negative figures: international producer and import products.

3.3. Components of quality, labelling, trademarks

The questions of the following block analysed the *components of quality, labelling and trademarks.* Firstly, *18 different factors and aspects influencing potentially the image of traditional products were analysed* (the scores from 1 to 5 indicate the importance – 1 is least, 5 is most important). The results are shown in **Table 6.**

Table 6. Importance of different factors determining the quality image of traditional Hungarian foods

Statement	N	Mean	Deviation	Mode
Unobjectionable freshness of the product.	996	4.74	0.60	5
Production should fulfil the legal requirements (e.g. hygiene)	993	4.73	0.57	5
Always the same flavour.	995	4.69	0.66	5
Should be made of natural raw materials.	993	4.67	0.66	5
Should be made of chemical-free raw materials.	991	4.67	0.67	5
Should be made of raw materials of domestic origin.	993	4.59	0.75	5
Should bear high enjoyment value.	993	4.56	0.70	5
Obvious identification of the producer.	992	4.54	0.79	5
Label warranting the domestic origin.	993	4.54	0.76	5
Recipe inherited from earlier generation.	988	4.54	0.78	5
Should be nutritious.	995	4.53	0.75	5
Should not contain E- numbered additives.	985	4.52	0.79	5
Warranty on traditional processing.	987	4.47	0.83	5
Brand-name should indicate Hungarian origin.	988	4.43	0.84	5
Hungarian producer and production.	989	4.40	0.87	5
Packaging should refer traditionalism.	987	4.28	0.90	5
Practical, easy-to-handle packaging.	991	4.15	0.93	5
Fast preparation, time sparing.	987	3.76	1.20	5

At the beginning of the list, food security aspects stand, such as freshness and fulfilling legal requirements. The reason for this can be the food scandals of the last years, and the fear from these is reflected in the answers. Then, the expectations towards the flavour typical for this product group follows. Afterwards, the natural and chemical-free raw materials stand, which are important in case of ordinary foods. According to the results, these are even more important than the domestic origin of raw materials, which also reflects on the importance of food security issues. Then, enjoyment value as important factor follows. At the beginning of the middle field, the importance of identifiability of the product: warranty of home origin and the obvious identification of the producer. It is also important to mention that all these factors have around the same weight: between the averages of the first and the tenth rank, the difference is only 0.2. Besides, the deviations are also relatively low (around 10 to 12 per cent), which reflects on the univocal judgment on these aspects. The results of the answers given on the last questions mean that the Hungarian consumers consider brand-name indicative of Hungarian origin and the type of packaging less important, which reflects on the higher importance of rational rather than emotional aspects. According to the answers of the consumers, the traditional foods are not typically fast food products and do not bear time sparing function.

The next question asked about the possible advantages of a *trademark of traditional products for consumers* on products without such labelling.

Around 80 per cent of the interviewed people would decide in favour of traditional Hungarian foods with trademark. However, the percentage (43.6%) of those who are willing to pay more for those traditional Hungarian foods with trademark is much lower. From one side, it reflects on the price sensitivity of the Hungarian consumers, and on the lack of strategy of this product category, from other side.

Those that are willing to pay higher price for traditional foods with trademark (N=436) *were asked to give the percentage of acceptable extra price in case of ten different product groups.*

Similarly to the earlier seen (Table 3 and 4), the majority of the people would pay less than 10 per cent. Most of them would pay more than 10 per cent for mineral waters and bakery products, while least of them for alcoholic drinks and meat products. The rank numbers (<10% = 1 ... >50% = 6) resulted different composition again. The first three places were taken by alcoholic drinks and meat products, while the last ones by bakery products and mineral waters, for the same reason as it was discussed in the previous.

3.4. Communication

In this block of the questions, the *information sources* of the consumers on ordinary foods were asked.

The order of the ranks is led by the nationwide television broadcasts. These are immediately followed by two reliable types of sources (friends, family). This reflects on that the information coming from mass medium is strongly filtered (by family, friends) and the reliability of the information is prejudged in this way. The results also show that this group of products enjoys a kind of status of trust. This information source is followed by advertisements, radio and Internet. Interestingly enough, local gazettes overtook the nationwide ones and the local televisions, as well. Informational books and local radios close the order. As other sources of information, leaflets and information given in the shops were mentioned in significant number.

4. CONCLUSIONS AND RECOMMENDATIONS

According to the results of the survey, the Hungarian consumers are more familiar with the definition of traditional foods and have better understanding of it; therefore it is recommended to use it in marketing communication. In order to better identify this product group, it is useful to create a unique labelling (trademark), which helps the consumers to get adequate information, and also stands as warranty of the product group. This trademark can promote the cooperation of the producers of traditional Hungarian foods, which may result is a better bargaining position. The information gained by the survey ensures opportunity for the foundation of a more effective marketing and an extensive reputation of this product group. Besides, these kinds of information may contribute to a general common marketing strategy, which will be a good guideline to create marketing strategy for certain product or product group in Hungary.

REFERENCES

1. Andrásfalvy A. (2003): A kertészeti hungarikumok sajátos minősége. (In Nyéki J., Papp J.: Kertészeti hungarikumok, 1-318). MTA Társadalomkutató Központ kiadványa. Budapest, 25-30.
2. Hoffmann M., Kozák Á., Veres Z.(2000): Piackutatás. Műszaki Könyvkiadó, 1-398.
3. Kovács F., Bodó I., Seregi J., Udovecz G. (2003): Őshonos állataink és termékeik, a hungarikumok. Magyarország az ezredfordulón. Stratégiai tanulmányok a Magyar Tudományos Akadémián. II. Az agrárium helyzete és jövője. MTA Társadalomkutató Központ kiadványa. Budapest, 1-239.

4. Malhotra, N. K. (2001): Marketingkutatás. Műszaki Könyvkiadó, Budapest, 1-904.
5. Nótári M. (2008): A kertészeti- és élelmiszeripari hungarikum termékek primer vizsgálata, különös tekintettel a Dél-alföldi Régióra. Doktori Értekezés. Budapesti Corvinus Egyetem, Élelmiszertudományi Kar, 1-146.
6. Popovics A., Gyenge B.(2006): A hagyományos magyar élelmiszerek fogyasztói magatartásának vizsgálata. EOQ MNB EU Közösségi Konferencia, Debrecen, 156-163.

DYNAMIC MODEL OF ROTOR BLADE BEHAVIOUR

Dénes Szilágyi
College of Nyíregyháza Department of Transportation Science and Infotechnology
H-4400. Nyíregyháza, Kótaji út. 9-11, Hungary
e-mail: szilagid@nyf.hu

ABSTRACT

There are more than 40 Ka-26 rotorcrafts today in Hungary. They have glass-fibre composite rotor blades had been constructed (at 1969) there were possibilities only for the static strengths analysis. Conversely the rotor blades are loaded by a lot of basically unsteady effects. For determination of them nowadays much more concinnity methods (theoretic examinations for example vortex theories; 1:1 rate wind tunnel tests; flight tests) are used. Unfortunately such methods are very expensive and they often give different results. For the successful calculation of dynamic loads of a rotor blade (mainly by a bottom blade of a coaxial system) with the possibilities are available for me in Hungary, I had to develop such method that has a satisfactory accuracy, take into consideration the unsteady effects, and easy realisable and usable with a PC. In this paper I presented analysis of aerodynamic-dynamic behaviour of the bottom rotor blade and the relation between the static and dynamic loads of the bottom rotor blade of coaxial rotor system using that aerodynamic-dynamic-aero elastic model. Results could give the base of the life time limit lengthen of that blades as validated by the present exploration.

1. INTRODUCTION

My aim was to establish a technical-mathematical model for write the aerodynamic-dynamic-aero elastic behaviour of coaxial rotor system in a steady linear flight. For reaching the goal I had to analyse the rigid and elastic blade motions, the flow area above the rotors and the aerodynamic forces acting on blades with taking into consideration the effect of top rotor and unsteady effects of variable flow too.

The base of calculation is the combined blade-element momentum theory with the ONERA model [1] for unsteady flow effects, with the effect of top blade tip vortexes and the effect of control system too. By this way the induced velocity field and the unsteady effects can be calculated. In case of success, these results can be used by the calculation of helicopter performance, equilibrium states, and finally but not at least for the investigation of rotor blade's life time with the calculation of the loads. The combined blade element momentum theory (BEMT or CBEMT), is a well known theoretical method [2, 3]. The zero resulted effects of blade tip vortices can be taken into consideration with using of the vortex theory complement added by me, which missed from the original theory. The present calculation method could be checked by the application of the results of KA-26 helicopter investigations have been implemented at 1990 in a co-operation of Technical University Aachen and Technical University Budapest [4].

2. THE MODEL AND RESULTS

For reaching the aim I have had to consider my strongly limited computational capacity and measuring possibility as well as the relatively simple programming ability and satisfactory accuracy, I have chosen the base of model the combined blade element momentum theory supplemented with effect of trailing vortices. Increasing the accuracy I have considered three movements of rotor blade, the flow above the rotor, the aerodynamic forces on the blade, the effects of top rotor, the unsteady flow around the profiles, the elastic deformations and the effect of tip vortices. For the solution of problem I have developed the model of Tamás Gausz Ph.D. written in version 3.5 of Power-Basic [5] and based on the combined blade-element momentum theory for single rotor case. I have used the MATLAB too mainly for filtering of the results of measurements and Microsoft Excel for completions of those processes were not programmed, and for the graphics.

In case of using the momentum theory the cross section of stream tube of the coaxial rotor system, what I have given as a function of the place along the rotor disc. By the way on a coordinated place knowing the distant flow velocity, the pressure and the density, the induced velocity could be simply determined by using of momentum theory. Using the blade-element theory in case of bottom rotor we have to consider even the classical components of the flow or the normal and tangential induced velocities of top rotor, the velocities are induced by the tip vortex of top rotor on the bottom rotor disc, the effect of tip vortex on the lift near the tips (the lift coefficient was decreased to zero with a polynomial by the tips) and the effect of unsteady flow on the profile characteristic with the ONERA model. By considering of the effects of top rotor those area is on the bottom rotor disturbed by the flow of top rotor had to be determined in the function of advance ratio [6]. Here the setting back of the stream tube was considered.

The flapping and feathering motions were considered with their simplified classical differential equation by this way consider with the control law and the effect of flapping compensation. In the computation the bending deformation was considered with the linear combination of the first four free vibration with their azimuthally coefficients, those azimuthally coefficients were very necessary for the calibration of the model and for the strength analysis too.

The computation process have two parts: In the first part the program calculates the induced velocity-distribution, thrust, horizontal and side forces of the top rotor. In the second step the program considers the foregoing computed and conformal positioned induced velocities of the top rotor additionally with the velocities induced by the top rotor tip vortices. In both parts calculations shall be stopped when reaching generalised equilibrium state of rotor blades.

For the calibration of model I have used the results of a measurement already was published in the [7] and was analysed in my previously papers [8] [9] [10]. Without detailing the base of the measurement was the signs of tensiometric stamps calibrated for unit-moment values on a bottom rotor blade of a Ka-26, flapping angle transmitter and rotation per minute transmitter were transmitted to the earth with a telemetric system during steady level flight with different advance ratio.

The differential equation of flexible chord can be easily solved numerically with the linear combination of the above mentioned azimuthally coefficients and free vibrations. So giving same operation parameters near the measured moment values could be calculated with the model, in a given azimuth and place along the rotor blade. For determination of the deviation between the measured and with a dipole Chebisev filtered and model computed moment values I have used a deviation function with the space of quadratic integral able functions, computed by scalar product and well usable in case of any constant approximation [11].

Table 1. shows the above mentioned deviations in case of μ=0,15 advance ratio. On the base of results above I have

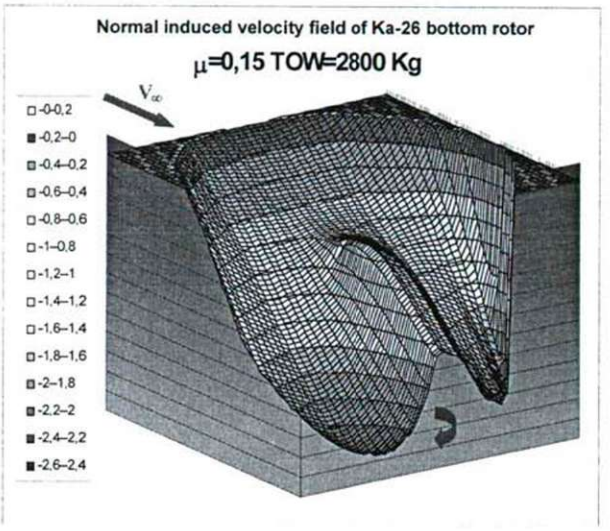
Table 1. Relative deviations of the two results on the measuring places

Meas. Places	No1	No2	No3	No4	No6	No7	No8
Deviation [%]	14,4	15,01	24,38	22,04	18,59	21,77	23,22

looked at the model as a valid one. The whole both the normal and tangential induced velocity field of the helicopter was calculated by different advance ratios as an aerodynamic application of model. One of these results (the induced velocity field of bottom rotor) is shown by the Figure 1.

The whole calculation of rotor blade's loads would be calculated with those movements were determined by the model so by this reason it would be possible the calculation of load on the base of static – with superposition of the external loads – and on the base of dynamic – calculation of the internal loads as to be in balance with external ones.

By the calculation of static bending load the following effects had been considered the moments and forces from the lift, the moments and forces from the lift centrifugal force, the moments and forces from the mass forces.



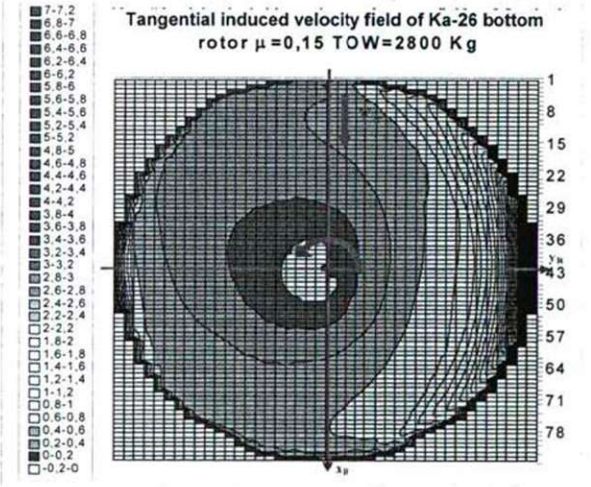


Figure 1. The normal and tangential induced velocity field of bottom rotor [m/s]

The internal stresses from the elastic and rigid bending motion were considered as the base of dynamic bending load. The following equations coming – from differential equation of flexible chord – were used to calculate the dynamic bending load as a bending moment:

(1) $$M_{DIN}(x_l,\psi) = IE(x_l)Y''(x_l,\psi)$$

and from this moment the stress in the outermost cord of the bended structure – in this case the bottom outermost fibre of the spar of rotor blade – can be calculated with the following equation:

(2) $$\sigma_{DEF} = \frac{\partial^2}{\partial x^2}\sum_{i=2}^{4}\Phi_i(x_l)H_i(\Psi)Ee(x_l)$$

The reduced stress values in the table 2. by both –dynamic and static too – cases were calculated with the following equation [12]:

(3) $$\sigma_{red} = \sqrt{\sigma_r^2 + 4\tau_V^2}$$

where in static case σ_r is a summary of follows: the bending moment from lift force, the bending moment from centrifugal force, the bending moment from mass force, tensile stress from centrifugal force. In case if shear only the lift was considered and related to the shear strength.

Table 2. Relative stresses and elongations

Adv. Ratio	$\sigma_{din}/\sigma_{stat}$	$\sigma_{redStat}/\sigma_B$	σ_{redDin}/σ_B	ε_{Stat} (m/m)	ε_{Din} (m/m)	τ_V/τ_B
μ=0,025	12/85 (14,1%)	135/420 (32,14%)	56/420 (13,33%)	0,0045	0,0019	2,8/40 (7%)
μ=0,15	15/180 (8,3%)	180/420 (42,85%)	60/420 (14,28%)	0,006	0,002	2,6/40 (6,5%)
μ=0,25	19/325 (5,8%)	330/420 (78,57%)	66/420 (15,71%)	0,011	0,0022	3,2/40 (8%)

In dynamic case σ_r is a summary of follows: internal stresses from elastic deformations due to dynamic forces, tensile stress from centrifugal force as above.

Table 2. shows the absolute and relative values of the stresses and elongations. The strength properties of rotor blade material were sourced from the literature [13].

The figure 2 and 3 show the distributions of the static and dynamic reduced stresses along the rotor disc.

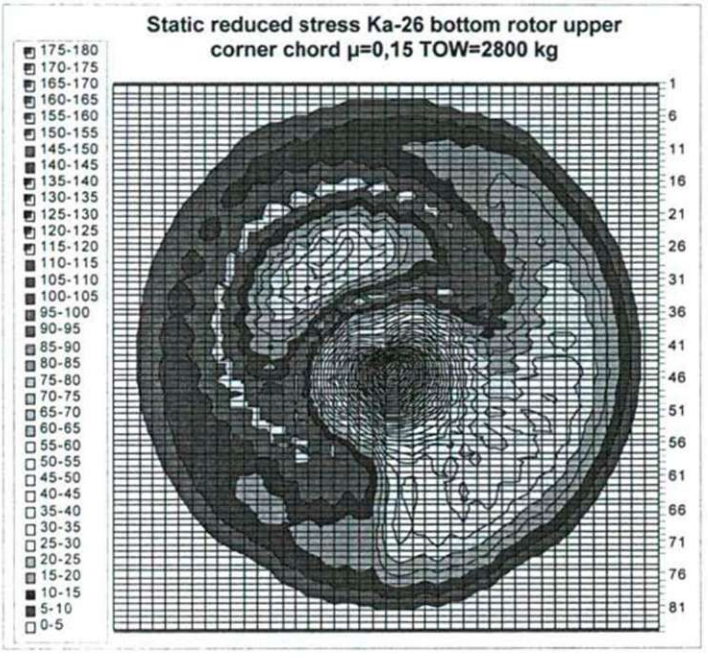


Figure 2. Distribution of static reduced stress [MPa]

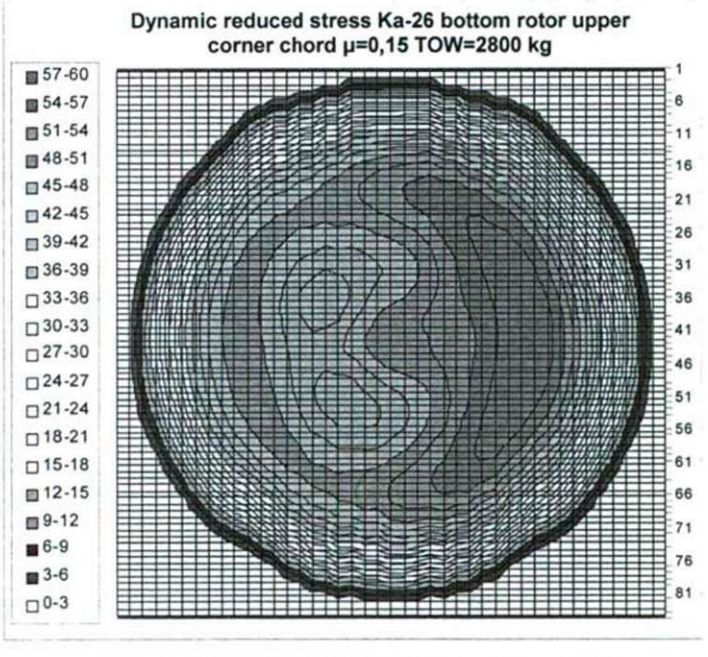


Figure 3. Distribution of the dynamic reduced stress [MPa]

3. CONCLUSIONS

Using this model the following could be state able:

1. The flow around the bottom rotor blades are not changed significantly due to the effect of induced velocity field of top rotor;
2. The diameter and place of the stream tube of top rotor is changed in the function of advance ratio and there is always an area to be not disturbed by the flow of top rotor;
3. The top blade's tip vortices act on the load of bottom blades only in case of medium advanced operation and the effect of the induced velocities is the higher in case of small advance or hanging. On the other hand in case of high speed operation the effects of top rotor on the loads of bottom one is insignificant. This figure 4 shows the effects of top rotor in the relative radius of 0,75 (is place is the place of No. 3 of the measure rotor blade) at the most often used advance ratio. The symbols in the figure are the follows:
   - No. 3 AERO: Results are calculated with the model considered with the most effects;
   - ÖN: Results are calculated with the model without the effect of top blade tip vortices;
   - FN: Results are calculated with the model without any effects of the top rotor.
4. It can be well seen on the base of values of the Table 2. that values calculated on the base of external loads and called for static are much more higher than those values are calculated on the base of deformations as internal stress (called dynamic) and really existing. This goes to show in real operation situation due to the fast change of loads the structure has no enough time to carry those loads were calculated on base of static point of view. Figure 5 as azimuthally intercepts well show the rate of static and dynamic stresses.

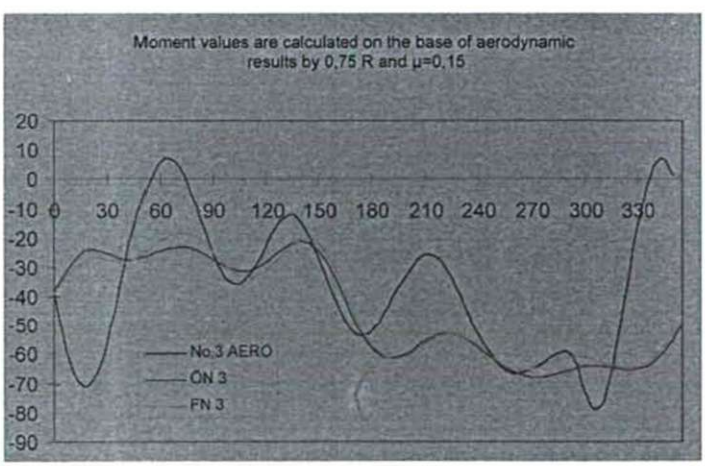


Figure 4. The effects of top rotor on the bending moment of bottom blades by medium advance

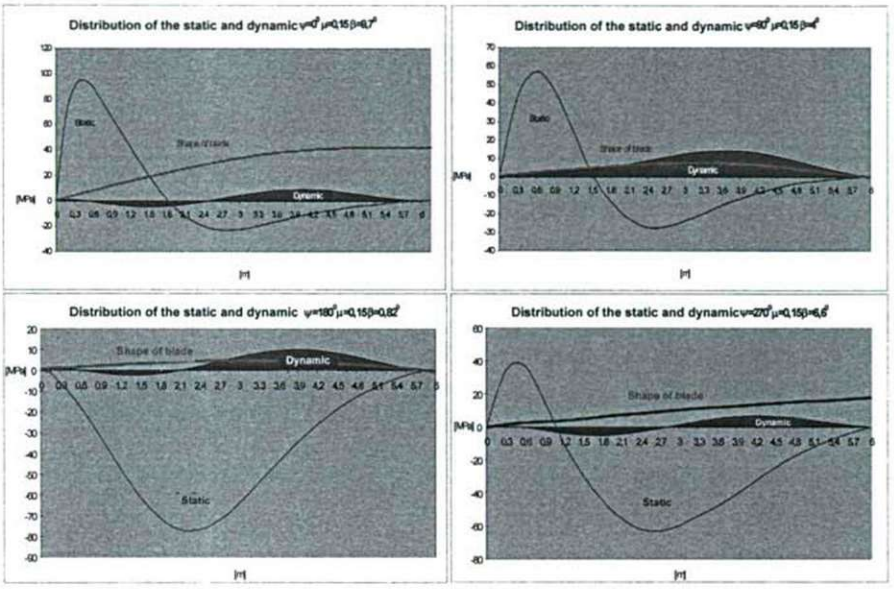


Figure 5. Azimuthally intercept of shape of blade and strength distributions

4. By this reason the rotor blades are constructed on the base of static aspect (forasmuch as the rotor blade of Ka-26 rotorcraft was constructed at 1959 and then were not so computational background as were able to determine the dynamic loads) are exaggerated structures.
5. Using dynamic loads new construction limits could be determined as a more economic solution or the life time of these structures could be lengthen on this base.
6. It is ascertainable that the relative elongation of rotor blades of Ka-26 helicopter exceeds nowhere the 0,004 value [14] [15] [16] [17] so by this way the life time of blade goes to the infinite when the mechanic loads are considered only. On this base (considered with practical experiences in the subject [18] the life time of the blades would be not infinite due to the environmental effects, but it is expectable this life time will be very high.
7. Presently we are working on the problem of environmental damage of the main spar performing deformation measures and destructive tests also. We have almost 100 results at every type of analysis based on Manufacturer's acceptance procedure. The freshest statistics show that the strength of this structure is basically in correlation with calendar time not with operation (hard) time. On the base of results of our present exploration expectable calendar limit of this rotor blades shall be more than 30 years instead of present 20 years, what was 6 years at the first step.

REFERENCES

1. Gausz, T. (1996): Helicopter Rotors Aerodynamics and Dynamics. 5th Mini Conference on Vehicle System Dynamics, Budapest. [1]
2. Gausz, T.(1982): Helicopters (in Hungarian). Postgraduate Institute of TU Budapest, pp. 50; 132-133. [2]
3. Stepniewsky, W.Z. (1979): Rotary-Wing Aerodynamics. Dover Publications, New York, pp. 87-88; 118-133. [3]
4. Lindert, H.W.: Flugmessungen mit dem Hubschrauber Ka-26 im Oktober 1990. Institut für Lichtbau RWTH-Aachen 1992. Measurement data. [4]
5. Nyéki, L.-Nagy, T. (1991): Turbo Basic LSI Oktatóközpont Budapest, [5]
6. Szilágyi, D.: (2001.09.12.-15.): Aerodynamic Investigation of Coaxial Rotor System. III. Avionics Conference Poland, Waplewo. [6]
7. Hungarian Air Force (1956): Aerodynamics, Budapest, pp. 201-210. [7]
8. Gausz, T. (1996): Helicopter Rotors Aerodynamics and Dynamics [8]
5th Mini Conference on Vehicle System Dynamics, Budapest.
9. Szilágyi, D. (1999. 01. 25): Dynamic Investigation of Rotor Blades Air Load poster MTA AMB 1999. Yearly Conference of Research and Development Gödöllő GATE . [9]
10. Szilágyi, D. (2000): Measurement of data required for Determination of Rotor Blades Air Load XVII. Conference of Aeronautical Sciences Szolnok. [10]
11. Bornstein, I. N.- Szemendyayev, K. A. (1987): Hanbook of Matematics. Technical Publisher, Budapest. [11]
12. Sályi, B. Dr. (1991): Mechanics Schoolbook Publisher, Budapest. [12]
13. Н. Ф. Суриков, Г. И. Иоффе, А. А. Дмитриев, Е. Г. Пак. (1982): Вертолет Ка-26. Транспорт. [13]
14. P.T. Curtis, A.J. Davies (Juni 2000): European Conference on Composite Materials ECCM-9, 4.-7., Brighton U.K. [14]
15. [1B.N. Cox, M.S. Dadkhah, W.L. Morris, G. Flintoff (1994): Acta Metallurgica et Materialia. [15]
16. S.D. Pandita, G. Huysmans, M. Wevers, I. Verpoest (18.-20. Sept. 2000): TexComp 5, 5th International Conference on Textile Composites, Leuven, Belgien. [16]
17. B. Graftieaux, A. Rezai, I. Partridge (Juni 2000): European Conference on Composite Materials ECCM-9, 4.-7., Brighton U.K. [17]
18. Hungarian Civil Aeronautical Authority (2002): Life time limits for Ka-26 rotorcraft, Directive No: 2002/R03, Budapest. [18]

EVALUATION OF OIL SEED BY-PRODUCTS AS POTENTIAL FOOD INGREDIENTS

J.Tarek-Tilistyák[a], J.Agócs[b], M. D-Tóth[a], M. Czapar[a], Z. Dinya[a], E. Máthé[a]
[a]College of Nyíregyháza, H-4400 Nyíregyháza, Sóstói út 31/b., Hungary
[b]ABO MILL Ltd., H-4400, Nyíregyháza, Simai út 6. Hungary
e-mail: judit.tilistyak@nyf.hu

ABSTRACT

The objective of our research work was to study the application of by-product of cold-pressed sunflower seed and cold-pressed pumpkin seed as ingredients of bakery and coatings. We made detailed chemical analysis to evaluate the nutritional value and made microbiological tests to know the safety of these materials. Food development trials were made. The pumpkin and sunflower seed by-products were found to be rich in nutritive and physiologically important compounds. High protein, dietary fibre and fat ratio. They had very high ratio of the unsaturated fatty acids, especially the essential linol acid (~60%/total fat). The by-products were found microbially safety. Application as food ingredients can be unique, because of the product's new look and claim of healthy product. For bread making, using of dough improvers are proposed, because of by-products' dough weakening effect. As coating (batter) ingredients for deep-fat frying, the pumpkin seed by-product was less effective to decrease the oil uptake, than the sunflower seed by-product.

1. INTRODUCTION

The by-products of cold-pressed sunflower-seed and pumpkin seed are rich in bioactive compounds e.g. protein, fiber, unsaturated fatty acids, phytosteroids, etc., which have many positive physiological effects. (Moure, 2006).These can reduce the risk of different diseases e.g. colon cancer, osteoporosis. So these materials can be suitable as functional ingredients in foodstuff.

The utilization possibilities are limited by not only the physiologically important chemical composition of the by-products, but also the compliance to the food safety rules. The ingredient used in the further food development also can not be harmful to the consumers' health. Microbial contamination (e.g. *Salmonella, mould number)* and chemical residue (e.g. mycotoxins, pesticides) have to be below the allowed limit values.

Nowadays these by-products are used in animal feeding. It is real challenge to make detailed evaluation for find the new utilization possibilities, and determined the economically fitting product prototype.

Inasmuch as the oil seed by-products are dry materials, plausible to use them in dry mixes, such can be for making breads, and the other one can be the coatings for fried foods. Bread is staple foodstuff. Different sorts of bread are consumed all around the world. Can we increase the nutritional value without changing the organoleptical properties of the product type, or can we develop new, unusual look? (Cauvain, 2003).

Deep-fat fried (DFF) battered products are very popular, but they adsorb significant amount of fat. The oil used in DFF not only increase the caloric content of the food and contribute nutritional and physiological elements, such as fat-soluble vitamins, but also increase the quantity of the oxidative derivates in the fried product. So it increases the risk of different diseases e.g. cardiovascular diseases, colon cancer etc. It is important to study

different coating formulas to reduce the oil uptake and possibly to increase the nutritional and physiological element ratio in the end product. (Gennadios et al. 1997)

The objective of our research work was to study the application of by-products of cold-pressed sunflower and pumpkin seed as functional ingredients in flour formulas for bakery and in fried products. We measured the chemical composition of these by-products, checked the microbiological contamination, and studied the application in mixed flours: determined the rheological properties, measured techno-functional properties e.g. coating adhesion and the oil content of deep-fried products.

2. MATERIALS AND METHODS

The by-products of cold-pressed sunflower and pumpkin seeds were brought from a Hungarian agricultural company. The hulled oil seeds were cold pressed. The extruded by-product were milled, then packed in opaque plastic bags, and stored in cool place to avoid from the degradation (e.g. oxidation, putrefaction).

Chemical analysis:
Water content: MSZ 6369-4:1987.
Protein: MSZ 6830-4:1981.
Total dietary fibre: MSZ 6884-3:1985, MSZ 6369-12:1979.
Fat: MSZ 6369-15:1982.
Fatty acids composition (SFA=saturated fatty acids, MUFA=monounsaturated fatty acids, PUFA=polyunsaturated fatty acids): Perkin Elmer Clarus 500; splitless PTV t=250°C; He 5.0(1ml/min); 70°(2')→(2°/p) →250°C(1')→(8°/p)→280°C(60'); FID (300°C).
Macro-and microelement composition: Sample extraction were made with the mixture of HNO_3:H_2SO_4:H_2O_2=4:1:1 (v/v) in microwave extractor. Perkin Elmer Optima 5300DV; RF:40MHz; RF power: 1300 W; torch injector diameter: 2 mm; Ar gas: 0,85 l/min; Ar flow rates: Aux: 1,5 l/ min, plasma: 15 l/min; sign: 3 pointed area; resolution: 0,006 at 200 nm.

Microbiological evaluation:
Total plate count determination: we incubated PCA (Merck) plates for 48 h at 30°C according to the MSZ ISO 4833:1999.
Mould number: YGC agar (Merck) was used for mould enumeration. Plates were incubated at 25°C for 5 days according to the MSZ ISO 7954:1999.
Coliform: BPLS agar was used for *Coliform* enumeration. Plates were incubated for 24 h at 37°C.

Measurements for food application:
As bread ingredients:
Mixed flour formulas' preparation: We mixed 4 basic flour formulas which were wheat flour (BL-80) and by-products in two ratios less than 10%, respectively (notation: P as pumpkin, S as sunflower; addition units: 1 Unit as 1U, 2 Units as 2U). We supplemented the basic flour formulas with inulin (BeneoHPX) or guar gum in 1 and 2%.
Rheological measurements: the formulas' humid gluten ratio, the stretching of humid gluten, the water absorption, degree of softening with Farinograph, the extensibility, the energy (breaking force), resistance to extension with Brabender Extensograph were determined.

As batter ingredients:

Batter (coating) preparation: We mixed wheat flour (BL-55) and by-product one-by one in the ratio of 7:3. The pre-blended dry ingredients were mixed with distilled water in a container by using a domestic Braun mixer for 30 sec. The dry/water mix proportion was 3:4 and 3:5.

Coating adhesion: The batter adhering to the sample during dipping was considered as the batter-pick up and was calculated as the mass of the coated samples divided by the uncoated one multiplied with 100, in triplicate.

Deep-fat frying process: Formed (1x1x4cm), coated pieces of celery were deep fat-fried in sunflower-seed oil at 180 °C for 4 minutes.

Measurement of oil absorption (uptake): Fried samples were extracted with 50 ml n-hexane in ultrasound for 15 min, in triplicate. After evaporating of n-hexane we measured the oil content gravimetrically.

3. RESULTS AND DISCUSSION

The application possibilities of oil seed by-products are influenced partly by the chemical composition and on the other hand the adequacy for the regulation of food safety. We measured these by-products' inside-values, shown in Table 1, determined the fatty acid composition (Table 2) and the distribution of different sorts of fatty acids (Table 3), the macro-and microelement composition (Table 4), and furthermore the vitamin content, shown in Table 5.

Table 1. Chemical content of oil seed by-products (g/100g).

Sample name	Water	Protein	Total dietary fibre	Soluble fibre	Fat	Ash	Carbo-hydrates
Pumpkin seed by-product	7,2	50,4	6,3	4,4	8,1	7,2	27,3
Sunflower seed by-product	7,6	48,5	15,3	12,7	9,2	7,0	22,4

Table 2. Fatty acid composition (%) of oil seed by-products.

Sample name	Total SFA (%)	Total MUFA (%)	Total PUFA (%)
Pumpkin seed by-product	16,0	22,2	61,7
Sunflower seed by-product	15,4	27,5	57,1

Table 3. Distribution of different sorts of fatty acids in oil seed by-products (%).

Fatty acid ratio / Sample name	SFA		MUFA		PUFA
	Palmitic acid 16:0	Stearic acid 18:0	Palmitoleic acid 16:1 (9)	Oleic acid 18:1 (9)	Linol acid 18:2 (9,12)
Pumpkin seed by-product	61,5	38,5	5,6	94,4	100
Sunflower seed by-product	64,3	28,6	4,0	96,0	100

Table 4. Macro and microelement content (mg/100g) of oil seed by-products.

Sample name	Na	K	Ca	Mg	Fe	Mn	Zn	Cu	P	Se
Pumpkin seed by-product	37,3	1810,2	95,4	1317,2	35,4	6,2	17,5	3	2510,9	0,008
Sunflower seed by-product	6,7	1522,1	253,6	893,5	14,7	4,7	12,1	3,9	1422,5	0,005

Table 5. Vitamin content of oil seed by-products (mg/100 g).

Sample name	C	B1	B2	B6	Niacin	Panthotenic acid	K	E
Pumpkin seed by-product	0,23	0,47	0,68	0,44	11,52	0,68	0,039	13,45
Sunflower seed by-product	0,06	3,66	0,67	1,52	13,71	17,65	0,13	22,08

Based on our results we stated the water content is very low which influences the further microbial propagation during the storage, thus the safety shelf-life.
These by-products are good for protein enrichment in food development because of their high protein content. The soluble fibre content increases not only the nutritional value, but also can have technological effect.
The ash content of this by-products is also very high, in comparison with the cereals' ones. Only the ash content of wheat bran approximates to be so high, we measured (Varga et al., 2008).
The oil residue of these by-products may have technological effect on the dough, we analyse below. We stated furthermore, that the high poly-and monounsaturated fatty acid content contribute to increase the nutritional value of the prospective food prototype development. The SFA content can give the representative aroma characters which can enhance the popularity of the developed prototype. The ratio of PUFA is 3-folds more, than the MUFA in the pumpkin seed by-product, while in the case of sunflower seed by-product PUFA ratio is 2-folds more. The PUFA content is represented by the essential linol acid, in both of the by-products.
The examined by-products are very rich in both water- and fat-soluble vitamins. In general we can say, that in comparison, the by-products' vitamin content is of an order higher, than the wheat germ's one. (Varga et al., 2008).
We summarized that the by-product of both the pumpkin seed and sunflower seed are rich in nutritive and functional components, so that they can be applicable as functional food ingredients.

Food processing, the raw materials and other food components e.g. ingredients used in food production are required the compliance to the food safety regulations. The oil-seed by-products must have to be safety for the consumer health. For this reason we made microbiological evaluation, to know the microbial safety of these raw materials at the beginning of any food application. We determined the total mesophyl microbe count, the number and the species of mould, and *Coliforms*.

Table 5. Initial microbial contamination of oil seed by-products.

Origin of by-product	Total plate count cfu/g	Mould number cfu/g	Coliforms cfu/g
Pumpkin seed	$3,5 \times 10^3$	$2,33 \times 10^2$	$7,0 \times 10^2$
Sunflower seed	$1,2 \times 10^3$	$4,66 \times 10^2$	-

We can see that the total mesophyl microbe count is higher in the case of pumpkin seed by-product, but acceptable low in the case of sunflower seed by-products. The mould number of the samples is relatively low. We identified *Mucor sp.* and *Penicillium sp.* in the pumpkin seed samples, and *Penicillium sp.* in the sunflower seed samples. According to the *Coliforms*' propagation we concluded that the sunflower seed by-product is adequate, but the pumpkin seed by-product can be infected.
From January 1st 2006 any food producing technology and process have to be adequate to the 2073/2005/EK, where is stated a regulation of hygiene for ready to eat fruits and vegetables. So the food sample has to be *Salmonella*-free. The *E. coli* number upper limit is 1000cfu/g. In the Hungarian regulation of 4/1998 EüM the maximum limit value for mould count is 10.000cfu/g, too.
Summing our results up, the microbial safety of the samples is adequate for the above mentioned legislations in force. But due to growing conditions the contamination of pumpkin seed by-product must be checked more regularly for *E.coli* and *Salmonella sp.*

We studied these oil seed by-products' applicability as ingredients in bread flour and in coating formula, the latter for deep-fat frying process. We measured rheological parameters, as below can be seen.

Table 6. Physical-chemical parameters of different flour formulas for bread making.

Sample name	Humid gluten (%)	Stretching (mm)	Industrial quality value	Water binding capacity (ml)
Control (BL-80)	31,20	1,0	A2	62,00
Pumpkin seed by-product 1U	30,50	3,0	B1	64,40
Pumpkin seed by-product 2U	30,60	4,5	B1	63,60
Sunflower seed by-product 1U	30,75	3,0	B1	63,00
Sunflower seed by-product 2U	30,65	3,5	B2	64,00

Replacement 1U or 2U of wheat flour with any of these by-products decreased the humid gluten ratio. The stretching numbers are increased in all cases. The industrial quality numbers and the stretching data harmonize, the dough softens. By the addition of oil seed by-products these mixed flours need to be supplemented with additives.

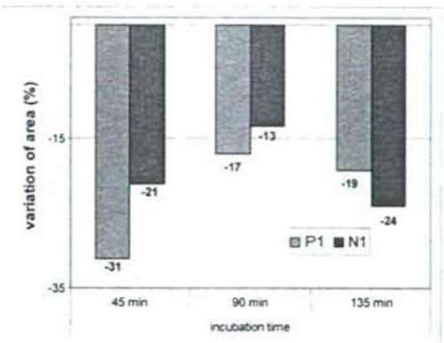


Figure 1. Changing of breaking force (area) in case of 1U wheat flour replacement with by-product.

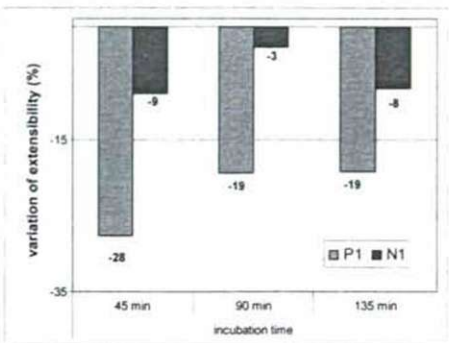


Figure 2. Changing of dough extensibility in case of 1U wheat flour replacement with by-product.

Addition of any by-product to the wheat flour, they soften the dough in every case. The dough extensibility changing values are better in case of sunflower seed by-product addition during the whole incubation time, compared with the pumpkin seed by-product addition.

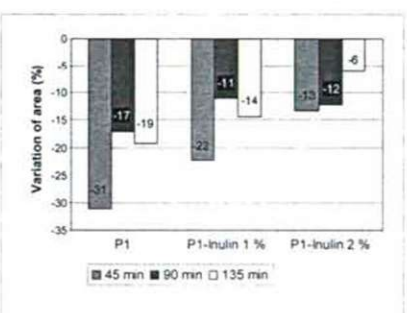


Figure 3. Effect of inulin addition on the change of breaking force in case of pumpkin seed by-product replacement

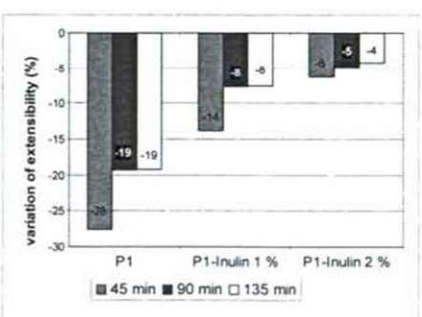


Figure 4. Effect of inulin addition on the change of dough extensibility in case of pumpkin seed by-product replacement

In short incubation period (45 min) every 1% inulin addition enhances the dough force. The dough softens after maximum incubation time on the effect of 1% inulin addition into the mixed flour replaced with pumpkin seed by-product. Increasing inulin ratios decrease the dough extensibility changing, so the mixed dough force converges to the wheat flour dough.

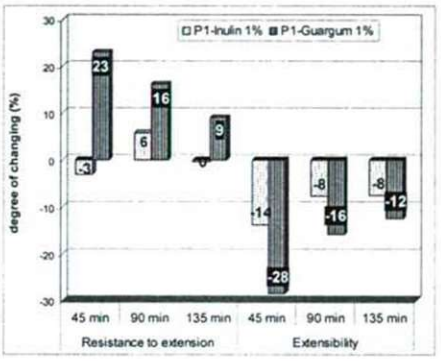


Figure 5. Effect of different additives on the characteristics of dough made with pumpkin seed by-product.

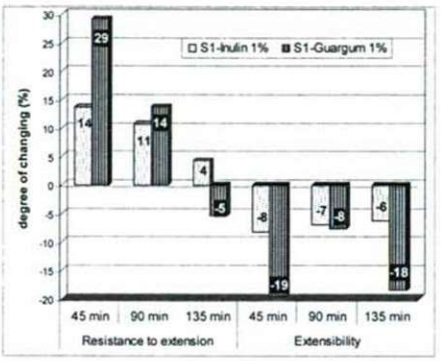


Figure 6. Effect of different additives on the characteristics of dough made with sunflower seed by-product.

The value of resistance to extension indicate the tolerance of dough kneading, in practice we can conclude the dough mashinability. Resistance to extension is better in case of oil-seed by-product addition than the wheat flour dough in both case of inulin or guar gum addition. Guar gum has more significant texture improver effect as compared with inulin in both dough supplemented with pumpkin seed or sunflower seed by-product. Strong dough is more knead able, but less extensible, the bread volume may be less.
Summing our results we concluded that the addition of oil seed by-products soften the dough. The pumpkin seed by-product addition makes bigger ratio of softening, than the sunflower seed by-product addition. So texture improvers need to be added into this dough or flour formulas. The examined, the inulin and the guar gum are good for using as improvers.

The oil seed by-products in coating formula for deep-fat frying were tried. The most important industrial and physiological parameters were determined, shown in Table 7. Coating adhesion is necessary to the making of uniform product; the knowledge of mass of oil absorption is necessary to healthy product preparation.

Table 7. Techno-functional parameters of different flour formulas as coatings.

Measured parameter	Coating adhesion (%)		Oil absorption (%)	
Dilution ratio (mixed flour:DW)	*3:4*	*3:5*	*3:4*	*3:5*
Coating with pumpkin seed by-product	141,2	56,3	7,94	22,98
Coating with sunflower seed by-product	178,0	89,5	7,73	13,67

Growing ratio of dilution affect significantly the coating pick up, in negative correlation. The sunflower seed by-product has higher total dietary fibre content, so it can bind more water, this coating is thicker. The thicker is the coating the bigger the adhesion. The ratio of oil absorption depends on the dilution. The weak is the coating the more fried the product. The weak is the coating on the food surface the more oil absorbs into the product.
Summarized, although the new look of a coating, the green colour of the pumpkin seed by-product coating might be amazing and popular, it looks it is physiologically less functional

than the other one which is added with sunflower seed by-product, because of the higher oil absorption values. In case of green coating (with pumpkin seed by-product, not with artificial colorants) using of thickening agents (e.g. bran) is proposed to increase coating adhesion and to reduce oil uptake.

REFERENCES

1. S.P. Cauvain (2003): Breadmaking. CRC press., p. 375-395.
2. Gennadios, M.A. Hanna, L.B. Kurth (1997): Application of edible coatings on meats, poultry and seafoods: A rewiev. Lebensm.-Wiss.u.-Techn., vol.30.pl. 337-350.
3. Moure, J. Sineiro, H. Dominguez, J.C. Parjó (2006): Functionality of oil seed protein products: A rewiev. Food Res. Int. vol. 39., 945-963.
4. Cs. Varga, J.T.Tilistyák, H.N. Uhrin, M. Szathmáry, J.L.Halász, Sz. Vígh, I. Demeter, Z. Dinya, E. Máthé (2008): Gabonafélék és őrleményeik elem és nyomelem tartalmának vizsgálata. 51. Magyar Spektrokémiai Vándorgyűlés, Nyíregyháza.

ESTIMATING SHELF-LIFE OF COTTAGE CHEESE BASED DESSERT PRODUCT

Mohamed Tarek[a], *Zoltán Győri*[b]
[a]Septoclean Bt., H-4531, Nyírpazony, Ifjuság u. 9, Hungary
[b]University of Debrecen, Centre for Agricultural Sciences and Engineering.
4032 Debrecen, Hungary, Böszörményi út 138.
e-mail: tilistyakj@t-online.hu

ABSTRACT

Cottage cheese based dessert samples were stored at three temperature: 10, 12, and 15 °C. Microbial counts were analyzed over time to determine the shelf-life. Mathematical analysis was used to calculate the shelf-life of the products by the mean of regression analysis. From results, examined dessert stored at 10 °C had a nominal shelf-life of 23 days, whereas dessert stored at 12 and 15 °C had a nominal shelf-life of 16 and 7 days.

1. INTRODUCTION

Consumer concern about treats associated with food is growing. Due to recent food crises in Europe, food quality and food safety become a hot topic in mass media. Food safety and food quality is a broader term, which means an assurance that food will not cause harm to the consumer when it is prepared and eaten according to its intended use (Raspor, 2008). Because food is inherently perishable and depending on its physical and chemical properties and the storage conditions, there comes a point when either its quality is unacceptable or it becomes harmful to the consumer. At this point it has reached the end of its shelf-life. The ability to predict the shelf-life is of great value to the food industry when defining storage and distribution conditions and limits, formulating products, assessing manufacturing process and doing quantitative risk assessment. It is important to identify which factors influence the shelf-life of the product.(Gacula and Kubula, 1975, Reichart, 2005) These may be microbiological, chemical or physical factors, the technology, the packaging and the storage conditions.
The use of mathematical models can help to reduce the need for storage trials, challenge tests, product reformulations and process modifications, which are labour intensive, time consuming and expensive.
In food microbiology, mathematical modelling techniques are commonly applied to predict growth or inactivation of spoilage bacteria and foodborne pathogens (Armitage, 1997; Pin and Baranyi, 1999).

In case of dairy products the shelf-life of raw milk depends on the hygiene of fresh milk, subsequent transport and storage conditions. Post heat treatment contamination by Gram negative psychrotrophic bacteria is the major determinant of shelf-life of pasteurized products. In cultured dairy products, yeast and mould contamination is the most usual cause of spoilage.

The aim of our recent study was to determine the shelf-life of cottage cheese based dessert products, which were produced by the determinative, multinational diary factory working in the North-Great Plain region of Hungary. We checked the hygiene level of producer factory and monitored the transportation and storage conditions in the supply chain. We made model experiment of storage at three different temperature to measure the yeast propagation and we calculated the mathematical equation of probability of shelf-life.

2. MATERIALS AND METHODS

Sampling: Checking the keeping of producer's protocol for transportation and storage conditions (in different depots and stores) we repeted sampling 14- times.
For storage model experiment samples of cottage cheese dessert were obtained on the day of production from the factory. Samples were collected, and were immediately stored at 10, 12, and 15°C. Storage temperatures varied ± 1 °C. For each day of sampling, physical-chemical and microbiologyical evaluation were made.
Fat content: The fat content was read from butyrometer vessel.
Total solid content: Total solid content of the sample were determined by using oven drying method. The difference in weight before and after drying for 4 hours at 100 °C gives the results of solid content.
Determination of transportation and storage temperature in depots: During packaging of product in the factory we put mobile, pre-programmed digital thermometers in three different identified product's pack. We placed these packs onto different product-pallets. The variation of temperature was monitored in 3 days. Data were recorded in every five minutes, and recovered with legal software.
Determination of core temperature of the product: we used ET-DM 9258 type manual digital thermometer, measuring were in duplicate.
Determination of *Enterobacteriaceae*: VRBD agar was used for the enumeration of *Enterobacteriaceae*. Plates were incubated at 37°C for 24 h.
Yeast and mould enumeration: YGC Agar was used for yeast and mould enumeration. Plates were incubated at 25°C for 5 days.
The experiment was repeated 14 times to collect sufficient data for mathematical-statistical analysis.

3. RESULTS AND DISCUSSION

For the first step we checked the hygiene of production process in case of the end-product. We did not detected presence of *Enterobacteriaceae* in any of the samples that means very high level of factory hygine.

We determined the null-point of the shelf-life experiment, the initial chemical and microbiological parameters of samples, shown below in Table 1.
However the results are confirmed to Hungarian laws, we can see that these parameters are very suitable for growing all kinds of examined microorganisms. In case of the cultured milk product the most important quality risk factor is the yeast number. For this reason potassium sorbate is used as preservative substance but it is not suitable enough because of its little effect on yeast at higher pH.

Table 1. Initial chemical and microbiological parameters of examined products

Parameters	Value	SD
pH	5,08	0,178
Dry matter (%)	53,03	0,112
Fat content (%)	8,97	0,072
Enterbacteriaceae (cfu/g)	<10	-
Yeast content (cfu/g)	<100	-
Mould content (cfu/g)	<100	-

We examined the variation of temperature during storage and transportation. Temperature was monitored in every 5 minutes.The results are shown in Table 2. We concluded, that in depots the storage temperature is adequate, but during the transportation the temperature was higher than the allowed maximum value, sometimes it was above 10 °C. The low temperature plays an important role aganist yeast growth in cottage cheese based dessert. The certificated storage temperature (defined by the producer) is between 2 and 10 °C. This low temperature must be applied in the food supply chain (production, transportation and storage).

Table 2. Temperature changing of examined products during storage and transportation.

	Storage temperature (°C) in depots	Transportation temperature (°C) on trucks
Average	3,68	9,65
SD	1,8	2,18

We also studied the core temperatures of cottage cheese based dessert in different shops. The results are shown in Table 3. The core temperature is sometimes above 15°C especially in retail shops.

Table 3. Storage temperature of examined products in various shops

	Average of core temperature (°C)	Standard deviation
Retail shops	13,10	5,47
Supermarket	7,57	1,27
Hypermarket	5,27	0,57

From the results above we can see that sometimes the storage temperature is higher, than the upper limit. This relatively high temperature influences the product shelf-life and may cause consumer complaint, based on typical, unpleasant yeast smell.

To determine the microbiological quality of examined samples we measured the yeast contamination, shown in Table 4. The results indicate that both the incubation temperature and storage period have strong effect on yeast propagation. The counts of yeast increase significantly thoughout the testing period (35 day) when the samples were stored at 10 °C. Samples stored at 12 and 15 °C showed more higher yeast counts throughout storage.

2008 290010 012008

Table 4. Logaritmic values of yeast contamination at different incubation temperature

Days of storage / Incubation temp.	0.	7.	14.	21.	28.	35.
10 °C	1,57	2,80	4,10	5,10	5,10	5,14
12 °C	1,57	3,06	4,44	5,77	5,51	5,51
15 °C	1,57	4,61	6,25	6,04		

We calculated the growth rate of yeast (shown in Table 5.) at different temperatures as $\Delta logN/\Delta t$, where N, as yeast number;
t, as incubation time.

Table 5. Growth rate (Δ logN / Δ t) of yeast in the product at different incubation temperature

	10 °C	12 °C	15 °C
growth rate (1/day)	0,126	0,134	0,361
SD	0,056	0,049	0,074

In this study we aimed to determine the shelf-life of examined products in relation of yeast number. The results are shown in Figure 1. Shelf life were calculated in case of yeast according to the equation :

$$\text{Shelf-life} = (\lg N_k - \lg N_0)/b,$$

where:

$\lg N_k$, as critical yeast number ($\lg N_k = 4{,}0$);
b, as growth rate (1/day);
$\lg N_0$, as initial yeast number.

The critical yeast number was declared by producer.

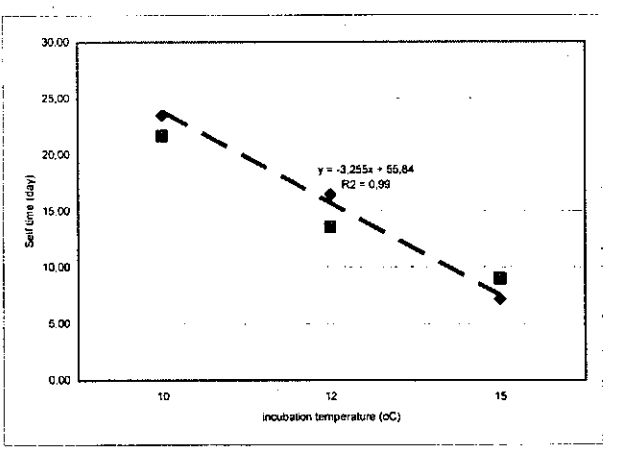


Figure 1. Shelf-life of the samples at different incubation temperatures

4. CONCLUSION

The cultured milk based dessert this type of dessert is the most famous in Hungary and very popular.
In the recent study we measured the chemical and microbiologyical parameters of these dairy products, which were adequate.
We checked the hygiene level of producer factory and we stated that it sufficient to the rules of food safety. We also monitored the transportation and storage condetions in the supply chain, and we concluded that those temperature not always fitted to the temperature specified by the producer.
We made model experiment of storage at three temperature to measure the yeast propagation. Samples were stored at three different temperature: 10, 12, and 15 °C. Microbial counts were analyzed over time. The results indicated that storage (incubation) temperature and storage time have strong effects on yeat propagation. The counts of yeast increase significantly throughout the testing period (35 day) when the samples were stored at 10 °C. Samples stored at 12 and 15 °C showed more higher counts throughout storage.
Mathematical analysis was used also to calculate the shelf-life of the products by the mean of regression analysis. From results, examined dessert stored at 10 °C had a nominal shelf-life of 23 days, whereas dessert stored at 12 and 15 °C had a nominal shelf-life of 16 and 7 days.
In spite of the fact that the producer is responsible for the safety of its products, it is evident that this responsibility has to be shared with transporter, retailer and consumer.

REFERENCES

1. Armitage, N.H (1997): Use of predictive microbiology in meat hygiene regulatory activity. International Journal of Food Microbiology, vol. 36, p. 103-109.
2. Gacula, M. C., Kubula, J. J. (1975): Statistical models for shelf-life failures. Journal of Food Science, p. 4404.
3. Pin, C., Baranyi, J. (1998): Predictive models are means to quantify the interactions of spoilage organisms. International Journal of Food Microbiology, vol. 41., p.59-72.
4. Raspor, P. (2008): Total food chain safety: how good practices can contribute?. Trends in Food Science & Technology, vol. 19. p. 405-412.
5. Reichart, O. (2005): Kísérlettervezés és értékelés a mikrobiológiai gyakorlatban. Jegyzet. Budapest, or http://www.muszeroldal.hu/measurenotes/reichardtcikk.pdf

ISSN 1788-6392

PUBLISHER:
Dr. Antal Véha
Dean, Head of Department
UNIVERSITY OF SZEGED FACULTY OF ENGINEERING

NUMBER OF COPIES PRINTED: 100
Norma Nyomdász Kft. Kiadó és Nyomda
6800 Hódmezővásárhely, Rárósi u. 10.

UNIVERSITY OF SZEGED
UNIVERSITAS SCIENTIARUM SZEGEDIENSIS
FACULTY OF ENGINEERING

www.mk.u-szeged.hu